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ABSTRACT

This document introduces the Alabama Graduation Examination Program (AGEP) which provides learning opportunities for high school students to meet the minimum competency requirements to earn a high school diploma in the state of Alabama. The Alabama High School Graduation Examination (AHSGE) content includes the subject areas of reading comprehension, language, mathematics, science, and social studies. This document provides information on the science standards, objectives teaching strategies, and motivational ideas. Science activities include: (1) "Producers-Consumers-Decomposers"; (2) "Pass the Energy Please"; (3) "Bubbling Oxygen"; (4) "Cycles of Nature"; (5) "Molecular Matters"; (6) "Periodic Table Bingo"; (7) "Bubble the Trouble Away"; (8) "Gymnosperm and Angiosperms"; (9) "Create a Flower"; (10) "A Grab for Grub"; (11) "Dork DNA"; (12) "Irregular Jeans"; (13) "It's a Toss Up"; (14) "Gone Fishing"; (15) "Osmosis in Purple Onion"; (15) "Plant and Animal Cells"; (16) "Poor Primitive Prokaryotes"; (17) "Window Cells"; (18) "Mitosis and Meiosis Motion Picture Flip Books"; (19) "Owl Pellets"; (20) "Energy Transfer"; (21) "Waves of Energy"; (22) "Motion Madness"; (23) "Push-Em Back"; and (24) "Fluid Pressure." The document also provides item specifications for science and reading comprehension. (YDS)

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ALABAMA HIGH SCHOOL GRADUATION EXAM

ED 458 112

TODAY'S STUDENTS, TOMORROW'S CITIZENS

PATHWAYS FOR LEARNING

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ALABAMA HIGH SCHOOL GRADUATION EXAM

TODAY'S STUDENTS, TOMORROW'S CITIZENS PATHWAYS FOR LEARNING

SCIENCE

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ACKNOWLEDGMENTS

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STATEMENT OF PURPOSE

This document consists of science activities and labs that can be used in combination with the *Alabama Course of Study: Science,* Bulletin 1995, No. 4, to prepare students for the *Alabama High School Graduation Exam.* The activities are not to be a substitute for course work with students. Activities address most, but not all, eligible content indicated in *Standards and Objectives (Reading Comprehension, Language, Mathematics, and Science) for Alabama High School Graduation Exam,* Bulletin 1997, No. 16. The activities may be modified for use with students who are of different ages, grades or achievement levels.

A copy of the science portion of *Standards and Objectives (Reading Comprehension, Language, Mathematics, and Science) for Alabama High School Graduation Exam,* Bulletin 1997, No. 16, in the form of a checklist has been included in this document on pages 10 - 18. Refer to this section when determining the Standard, Objective, and Eligible Content for each activity. These will only be listed on the activity as Roman numerals, numbers, and letters respectively. The Eligible Content overlaps in many objectives and, by reviewing this section often, instructors can be reminded of related content. The checklists included in this section help instructors keep a record of when eligible content is taught and assessed.

Instructors may find incorporated into each of the science labs and activities connections to the Reading Comprehension standards and objectives of *Standards and Objectives (Reading Comprehension, Language, Mathematics, and Science) for Alabama High School Graduation Exam,* Bulletin 1997, No. 16. These Reading Comprehension standards and objectives are listed as Roman numerals and numbers. Refer to page B-11 to determine the Reading Comprehension standards and objectives that are integrated into each lab and science activity.

A. GENERAL INFORMATION

GENERAL INFORMATION ABOUT THE ALABAMA HIGH SCHOOL GRADUATION EXAM (AHSGE)
THIRD EDITION

WHAT IS THE ALABAMA GRADUATION EXAMINATION PROGRAM?

The Alabama Graduation Examination Program had its beginning with the April 27, 1977, State Board of Education resolution that mandated that the State Superintendent of Education appoint a committee to develop minimum competencies for high school graduation and to establish plans for measuring those skills. The graduation examination program that grew out of this resolution had as its goal that all Alabama students should have the opportunity to learn the minimum competencies necessary to earn an Alabama high school diploma. There are three editions of the graduation examination. They are as follows:

- *Alabama High School Graduation Examination,* First Edition (AHSGE) – Requirement for any student who was a ninth-grader for the first time on or after the 1981-1982 scholastic year (Class of 1985)
- *High School Basic Skills Exit Exam,* Second Edition (Exit Exam) – Requirement for any student who was a ninth-grader for the first time on or after the 1989-1990 scholastic year (Class of 1993)
- *Alabama High School Graduation Exam,* Third Edition (AHSGE) – Requirement for any student who was a ninth-grader for the first time on or after the 1997-1998 scholastic year (Class of 2001)

The State Department of Education (SDE) has discontinued the administration of the first edition of the graduation examination.

With each new edition, the content of the exam was changed to reflect the increased course requirements for graduation. The third edition is aligned with the course requirements for graduation as adopted by the State Board of Education on April 11, 1996.

WHAT WERE THE STEPS IN DEVELOPING THE AHSGE, THIRD EDITION?

In 1996 the State Board of Education asked the SDE to develop a new graduation examination that would be aligned with new course requirements for graduation. The Test Advisory Committee, composed of educators from all parts of the state, recommended the broad areas to be assessed. In February 1997 the State Board of Education adopted these broad areas.

The Standards and Objectives Committees, composed of teachers representing all parts of the state, using the course of study for each subject area, recommended the standards and objectives for reading comprehension, language, mathematics, science, and social studies to be assessed on the AHSGE.

The proposed standards and objectives were submitted for review to subject-area specialists and educators in all local education agencies, institutions of higher education, and state organizations. Their recommendations were reviewed, and the standards and objectives were refined based on these recommendations. The State Board of Education approved the standards and objectives.

The SDE contracted with a testing company to write the test specifications (eligible content) and test questions for each subject-area test. The Test Specifications Committees, composed of teachers in the state, reviewed, modified, and approved the test specifications. Using these specifications, the items were written by the testing company for each subject-area test. The Content and Bias Review Committees, composed of educators from all parts of the state, reviewed and revised all test items for content and bias. The Content and Bias Review Committees approved all items before they were piloted. The items for the reading, language, mathematics, and science subject-area tests were piloted during the 1997-98 school year. The items for the social studies subject-area test will be piloted during the 1998-99 school year.

WHAT IS THE GENERAL CONTENT OF THE AHSGE?

Reading Comprehension (Reading) Subject-Area Test

The reading subject-area test requires students to read and comprehend articles, poems, editorials, essays, manuals, catalogues, and/or schedules. The reading selections will range from approximately 600-1200 words.

Language Subject-Area Test

The language subject-area test requires students to apply correct grammar and usage, correct capitalization and punctuation, appropriate word choice, correct sentence structure, and appropriate organizational skills for writing/revising.

Mathematics Subject-Area Test

The mathematics subject-area test requires students to perform basic operations on algebraic expressions, to solve equations and inequalities, to apply concepts related to functions, to apply formulas (while being supplied the formula), to apply graphing techniques, to represent problem situations, and to solve problems involving a variety of algebraic and geometric concepts. A page of formulas will be included in each test booklet. Calculators will be provided for each student, although a calculator is not needed in order to solve the problems. The state-provided calculator is a four-function calculator with percent, +/-, and square root keys. Each key performs a single function. Approximately 75% of the test is Algebra I content and 25% of the test is pre-geometry content.

Science Subject-Area Test

The science subject-area test requires students to apply concepts dealing with the nature of science, matter, diversity of life, heredity, cells, interdependence, energy, and force and motion. The Periodic Table will be provided in each test booklet. Approximately 70% of the test is related to biology and 30% of the test is related to physical science.

Social Studies Subject-Area Test

The social studies subject-area test requires students to know content related to the:

- Global influence of the pre-colonial and colonial eras of the Western Hemisphere
- Formation and development of the United States
- Eras of revolution, expansion, and reform prior to the United States Civil War
- United States Civil War era
- Developments of the late 19th to the early 20th centuries
- Causes and effects of World War I
- Great Depression and World War II

(This subject-area test will not be a part of the AHSGE until the spring of 2000, Class of 2002.)

WHAT IS THE PRE-GRADUATION EXAMINATION?

Students will take the pre-graduation examination during the spring of Grade 10. The *Alabama High School Graduation Exam*, Third Edition, is the pre-graduation examination. The pre-graduation examination is intended as a "checkpoint" for students, parents, and teachers so that students' strengths and weaknesses on the content of the AHSGE may be identified. However, should students pass one or more subject-area tests of this examination, they will be given credit toward graduation for passing the subject-area test(s).

WHO TAKES THE PRE-GRADUATION EXAMINATION?

Any student who, at the time of the **spring** administration of the graduation examination, is identified by the school as a tenth-grader **and** reported as such to the central office in attendance records is eligible to take the pre-graduation examination.

WHEN WILL THE PASSING SCORE FOR EACH SUBJECT-AREA TEST OF THE AHSGE BE ESTABLISHED?

The passing score for reading, language, mathematics, and science subject-area tests will be determined after the spring 2000 administration of the AHSGE. The passing score for the social studies subject-area test will be determined after the spring 2001 administration of the AHSGE. It should be noted that tenth-graders taking the pre-graduation examination in spring 1999 will not know if they passed the reading, language, mathematics, and science subject-area tests until after the passing score is established in spring 2000. Therefore, these students will have to take the reading, language, mathematics, and science subject-area tests of the AHSGE in spring 2000. However, if students pass in spring 1999 or spring 2000, they will be given credit toward graduation. Also, tenth-graders taking the social studies subject-area test of the pre-graduation examination in spring 2000 will not know if they passed until after the passing score is established in spring 2001. Therefore, these students will have to take the social studies subject-area test of the AHSGE in spring 2001. However, if students pass in spring 2000 or spring 2001, they will be given credit toward graduation.

WHO MUST TAKE A GRADUATION EXAMINATION?

Since the spring of 1985, all students who receive an Alabama high school diploma from a public school in Alabama must have passed a graduation examination.

Effective July 1, 1995, all students who enroll in an adult diploma program and receive an Alabama high school diploma from a public school in Alabama must have passed a graduation examination.

DO NON-PUBLIC SCHOOL STUDENTS HAVE TO TAKE A GRADUATION EXAMINATION?

No, however, non-public school students may elect to take the graduation examination. If a non-public school student who is enrolled in a private school wants to take the examination, all eligible students of the private school must take the examination. If non-public school students wish to take the examination, they must register with a local public school and pay a fee to the local public school to take the examination. They must take the examination at an assigned public school location.

IF STUDENTS ARE TAKING THE CURRENT HIGH SCHOOL BASIC SKILLS EXIT EXAM (EXIT EXAM), WILL THEY HAVE TO TAKE THE NEW GRADUATION EXAM?

No, students who are currently taking the Exit Exam (Second Edition) will continue to take that edition until it is phased out in several years.

WHO MUST TAKE THE AHSGE, THIRD EDITION?

Any student who was a ninth-grader for the first time in the 1997-98 scholastic year will have to pass the *Alabama High School Graduation Exam* which measures the standards and objectives contained in *Standards and Objectives (Reading Comprehension, Language, Mathematics, and Science) for Alabama High School Graduation Exam*, Bulletin 1997, No. 16.

Any student who was a ninth-grader for the first time on or after the 1998-99 scholastic year will have to pass the *Alabama High School Graduation Exam* which measures the standards and objectives contained in *Standards and Objectives (Reading Comprehension, Language, Mathematics, and Science) for Alabama High School Graduation Exam*, Bulletin 1997, No. 16, and *Standards and Objectives (Social Studies) for Alabama High School Graduation Exam*, Bulletin 1998, No. 13.

Effective July 1, 2000, students enrolling in an adult diploma program will have to pass the *Alabama High School Graduation Exam* which measures the standards and objectives contained in *Standards and Objectives (Reading Comprehension, Language, Mathematics, and Science) for Alabama High School Graduation Exam*, Bulletin 1997, No. 16.

Effective July 1, 2001, students enrolling in an adult diploma program will have to pass the *Alabama High School Graduation Exam* which measures the standards and objectives contained in *Standards and Objectives (Reading Comprehension, Language, Mathematics, and Science) for Alabama High School Graduation Exam* Bulletin 1997, No. 16, and *Standards and Objectives (Social Studies) for Alabama High School Graduation Exam*, Bulletin 1998, No. 13.

WHEN WILL THE GRADUATION EXAMINATIONS BE ADMINISTERED?

Opportunities

Students following the normal rate of progression in Grades 9-12 are provided four opportunities to take the AHSGE. These four opportunities are defined as the spring administration in the eleventh grade and the fall, midyear, and spring administrations in the twelfth grade. Students will also have an option to take the AHSGE during the summer between the eleventh and twelfth grades at a site to be determined by the local school system.

Testing Dates

The graduation examination will be administered over a five-day period. Tentative dates set aside for administration of the graduation examination are:

- Middle to end of September
- Beginning to middle of December
- Middle to end of March
- Middle to end of July (optional opportunity)

Students will take one subject-area test per day as follows:

- Monday – Reading
- Tuesday – Language
- Wednesday – Mathematics
- Thursday – Science
- Friday – Social Studies

Testing Time

The graduation examination is untimed; however, students may not receive an unreasonable amount of time that would interfere with other school requirements. Each day's testing should be scheduled for approximately three hours, with provisions made for students who need more time.

HOW MANY OPPORTUNITIES WILL A STUDENT HAVE TO TAKE THE TEST AFTER EXITING SCHOOL?

Exited students may continue to take any subject-area test at every regularly scheduled administration for as long as the student wishes to take the subject-area test(s) in order to earn an Alabama high school diploma.

WHO IS AN ELEVENTH-GRADER?

Any student who, at the time of the spring administration of the graduation examination, is identified by the school as an eleventh-grader **and** reported as such to the central office in attendance records is eligible to take the AHSGE.

HOW WILL STUDENTS BE INFORMED ABOUT THE GRADUATION EXAMINATION?

Notification of the Requirement to Pass the Graduation Examination

The graduation examination requirement brochure provides facts pertaining to the graduation examination. All students must receive this brochure when they enter the ninth grade. Parents and students must sign and return the signature portion of the brochure to the high school to indicate that they have received notification of the requirement to pass the graduation examination. Transfer students in the ninth grade or above must receive the same brochure as the students in his/her grade received immediately upon enrollment in the school.

Notification of Test Results

Local Education Agencies (LEAs) are responsible for notifying students and parents of the results of the graduation examination. The SDE will provide LEAs with two copies of the student label which indicates "Pass" or "Fail" for each subject-area test. One label must be placed in the student's cumulative folder, and the other must be given to the student/parent. If a student fails any subject-area test of the examination, the SDE will provide LEAs with two copies of the individual report. The individual report indicates deficiencies for each subject-area test failed. The LEA must design remediation plans for students utilizing the information provided by the SDE.

WHAT TYPE ITEMS WILL BE ON THE AHSGE, THIRD EDITION?

The test items are multiple-choice with four answer choices. The answer choices for odd-numbered items will be A, B, C, and D. The answer choices for even-numbered items will be E, F, G, and H.

HOW MANY TEST QUESTIONS WILL BE ON EACH SUBJECT-AREA TEST?

The number of items on each subject-area test is as follows:

- Reading – 84 items
- Language – 100 items
- Mathematics – 100 items
- Science – 100 items
- Social Studies – 100 items

WHAT IF A STUDENT COMPLETES ALL COURSE CREDIT REQUIREMENTS BY THE END OF THE TWELFTH GRADE, BUT STILL HAS NOT PASSED THE GRADUATION EXAMINATION?

A student may elect to return to school for remediation for the graduation examination until the age of 21. The school is responsible for providing the remediation. It is a local decision, however, as to how this remediation will take place. A student may continue to take the graduation examination for an unlimited number of times.

HOW DO STUDENTS PREPARE FOR THE GRADUATION EXAMINATION?

Students will need to **master** course content as outlined in the Alabama Courses of Study in English Language Arts, Mathematics, Science, and Social Studies and to retain the fundamental knowledge learned in those courses.

HOW SHOULD EACH SCHOOL SYSTEM DOCUMENT CURRICULAR AND INSTRUCTIONAL VALIDITY FOR THE AHSGE, THIRD EDITION?

School systems must have a comprehensive plan which specifies that the objectives are taught to students in grades as they progress through school.

In order to ensure curricular and instructional validity, the LEAs must include the following in their plans:

- The teaching of the objectives **before** students are tested.

- For any objective with less than 75% of the items correct after the administration of the **pre-graduation** examination, the reteaching of these objectives if the student has successfully completed the course, **or** the scheduling of the student for the course if the student has not successfully completed the course.

- The reteaching of objectives with less than 75% of the items correct on an individual basis after the administration of the **graduation** examination for students who fail any subject-area test.

To document the teaching of objectives before students are tested on them, LEAs should have their plans organized to include the objectives in their course descriptions, scope and sequences, and lesson plans. The LEAs must be able to document that these objectives are included on classroom tests. Documentation of the teaching and testing of the objectives reflects that students have been given the opportunity to learn these objectives as they progress through the grades.

Teachers have the responsibility for assisting students on any objective on which they have less than 75% of the items correct as indicated on the pre-graduation examination individual reports. These objectives should be emphasized and integrated appropriately in the curriculum. Reteaching should be guided by Item Specifications. Students who have not mastered a particular objective should be provided appropriate, alternative instructional strategies.

Following each graduation examination administration, any student who fails a subject-area test(s) **must** be retaught any objective with less than 75% of the items correct. This reteaching must be documented on a form(s) that includes, but may not be limited to, the following:

- The name of the student.
- Each objective in each of the subject areas (reading, language, mathematics, science, and social studies) where the student did not achieve 75% of the items correct.
- Spaces beside each objective where the dates of reteaching and the initials of the person doing the reteaching are recorded.
- Space for naming activities/materials used in reteaching.

In addition to the individual documentation form, samples of the student's work including classroom tests **must** be retained.

For students passing the graduation examination by the end of their twelfth-grade year, documentation must be retained for four years after their graduation. (Example: John Jones has passed the graduation examination, met course credit requirements, and graduated in May 1999. His documentation must be kept on file until 2003.)

For students not passing the graduation examination, documentation must be retained until four years after they successfully complete the graduation examination or until four years following the student's last attempt to pass the graduation examination. (LEAs must also adhere to all other regulations regarding the documentation and retention of records for students of special populations.)

B. SUBJECT-AREA TEST INFORMATION

Alabama High School Graduation Exam (AHSGE)

Science Subject-Area Test Information

Areas of learning in Grades K-6 include the following science knowledge and application processes. Development of these skills enables success in the courses assessed on the *Alabama High School Graduation Exam*. The K-6 curriculum includes:

- ***Scientific Processes***
- ***Scientific Knowledge***
  Earth and Space Science
  Physical Science
  Life Science
- ***Scientific Applications***

The processes, knowledge, and application of science introduced in **Grades 7- 8** in physical and life science expand student scientific knowledge of concepts learned in Grades K-6. Learning in **Grades 9-12** focuses on the traditional disciplines of biology, chemistry, and physics with the expanded courses that offer more detailed study of an area. Courses included for Grades 7-12 in the *Alabama Course of Study: Science*, Bulletin 1995, No. 4, will be helpful to students in preparing for the graduation examination. These include but are not limited to:

- ***Life Science***
- ***Biology***
- ***Marine Science***
- ***Anatomy and Physiology***
- ***Ecology***
- ***Physical Science***
- ***Earth and Space Science***
- ***Physics***
- ***Chemistry***

Students should obtain strong reading skills and an understanding of scientific processes. Since 70% of the science portion of the graduation examination is Biology and 30% Physical Science, there must be a foundation developed in Grades K-6 to prepare students for acquisition of the needed content, application skills, and vocabulary in Grades 7-12. Include these teaching, strategies and opportunities for students to:

- ***Apply knowledge***
- ***Develop a hypothesis***
- ***Interpret data***
- ***Use equipment and instruments***
- ***Learn lab safety***
- ***Use charts and graphs***
- ***Analyze and solve problems***
- ***Sequence information***
- ***Identify and distinguish***
- ***Compare and contrast***

ALABAMA HIGH SCHOOL GRADUATION EXAM
SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

TEACHER ____________________ SCHOOL ____________________________

STANDARD I The student will understand concepts dealing with the nature of science.												Course of Study Eligible Content Found in Course of Study Pages Gr. = grade P(p). = page(s) Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 1.	Analyze the methods of science used to identify and solve problems. Number of Items: 7	Physical Science	Life Science	Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science					
TEST ELIGIBLE CONTENT															
a.	Use process skills to interpret data from graphs, tables, and charts.											Gr. 7 – pp. 76 – 78			______
b.	Identify and distinguish between controls and variables in a scientific investigation.											Gr. 8 – pp. 86 – 88			______
c.	Identify safe laboratory procedures when handling chemicals, using Bunsen burners, and using laboratory glassware.											Bio. – pp. 115 - 116			______
d.	Identify and use appropriate Systeme International (SI) units for measuring dimensions, volume, and mass.														______
e.	Define and identify examples of hypotheses.														______
f.	Order the proper sequence of steps within the scientific process.														______
g.	Select appropriate laboratory glassware, balances, time measuring equipment, and optical instruments to conduct an investigation.														______

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ALABAMA HIGH SCHOOL GRADUATION EXAM
SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

STANDARD II:	The student will understand concepts dealing with matter.	Physical Science	Life Science	Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade P(p). = page(s) Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 1.	Trace the transfer of matter and energy through biological systems. Number of Items: 8														
TEST ELIGIBLE CONTENT a. Identify, define, and distinguish among producers (autotrophs), consumers, and decomposers (heterotrophs). b. Trace the flow of energy through food chains, food webs, and energy pyramids. c. Identify the reactants and products associated with photosynthesis and cellular respiration and the purpose of these two processes. d. Describe the carbon, nitrogen, and water cycles including transpiration and respiration.												Gr. 7 – p. 79, p. 82, p. 83 Bio. – p. 117			
OBJ. 2.	Relate particle motion to the states of matter (solids, liquids, and gases). Number of Items: 4														
TEST ELIGIBLE CONTENT Identify states of matter in terms of molecular (particle) movement, density, and kinetic energy associated with each phase/state of a given type of matter.												Gr. 7 – p. 80			

ALABAMA HIGH SCHOOL GRADUATION EXAM

SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

STANDARD II:	The student will understand concepts dealing with matter. (cont.)	Physical Science	Life Science	Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade P(p). = page(s) Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 3.	Apply information from the periodic table and make predictions using the organization of the periodic table. Number of Items: 4														
TEST ELIGIBLE CONTENT	a. Determine the number of protons, neutrons, electrons, and mass of an element using the periodic table. b. Use the periodic table to identify and locate metals, nonmetals, metalloids, and noble gases. c. Use data about the number of electrons in the outer electron shell of an atom, including simple dot diagrams, to determine its stability/reactivity and be able to predict ionic charge resulting from reactions.											Gr. 7 – pp. 80 – 81 Gr. 8 - p. 90			
OBJ. 4.	Identify how factors affect rates of physical and chemical changes. Number of Items: 4														
TEST ELIGIBLE CONTENT	Demonstrate knowledge that some factors and substances can affect the rate at which physical and chemical changes occur in living and non-living systems--such as the digestive process. Note: Factors and substances include such things as temperature, concentration, surface area, and catalysts--including enzymes.											Gr. 8 - p. 90 Bio. – p. 119			

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ALABAMA HIGH SCHOOL GRADUATION EXAM
SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

STANDARD III.	The student will understand concepts of the diversity of life.	Physical Science	Life Science	Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade P(p). = page(s) Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 1.	Distinguish among the taxonomic groups by major characteristics. Number of Items: 4														
TEST ELIGIBLE CONTENT a. Recognize the correct sequence or taxonomic classification of organisms from the most inclusive level to the least inclusive level. This may include use of a chart to compare two species and to identify the classification level at which one species no longer shares common characteristics with other species. b. Classify organisms into the five kingdoms based on recognizing two or more characteristics associated with organisms in a given kingdom. c. Recognize properly written scientific names using binomial nomenclature.												Gr. 7 – p. 82 Bio. - p. 117			
OBJ. 2.	Differentiate structures, functions, and characteristics of plants. Number of Items: 8														
TEST ELIGIBLE CONTENT a. Identify various plants as being vascular or nonvascular and describe the basic mechanisms by which vascular and nonvascular plants sustain themselves. b. Identify the distinguishing characteristics of angiosperms and gymnosperms in terms of their structures and reproduction. c. Identify reproductive structures and their functions in angiosperms. d. Demonstrate knowledge of which characteristics/traits would be best suited for plants growing in different environments and/or exposed to different pests.												Bio. – p. 117			

ALABAMA HIGH SCHOOL GRADUATION EXAM
SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

STANDARD III	The student will understand concepts of the diversity of life. (cont.)			Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade P(p). = page(s) Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 3.	Differentiate structures, functions, and characteristics of animals. 10	Physical Science	Life Science												
TEST ELIGIBLE CONTENT a. Distinguish characteristics of vertebrates and invertebrates in terms of a broad but basic range of physical and reproductive traits. b. Explain how animals are adapted to their environment – such as protective coloration, mimicry, claws, beaks, etc.												Gr. 8 – p. 92 Bio. – p. 117			______ ______
STANDARD IV	The student will understand concepts of heredity			Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. .= grade P(p). = page(s) Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 1.	Recognize heritable characteristics of organisms. Number of Items: 4	Physical Science	Life Science												
TEST ELIGIBLE CONTENT a. Identify physical traits that are passed from parents to offspring. b. Recognize how genetic traits including diseases and disorders are passed from one generation to the next. This may include family pedigrees and monohybrid Punnett squares. c. Identify what happens to the DNA code when a mutation occurs and identify the major causes of mutations. d. Recognize and evaluate the harms and benefits that result when mutations occur.												Gr. 8 – p. 92 Bio. – p. 118_			______ ______ ______ ______

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ALABAMA HIGH SCHOOL GRADUATION EXAM

SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

STANDARD IV: The student will understand concepts of heredity (cont.)

OBJ. 2.	Explain how the DNA molecule transfers genetic information from parent to offspring. Number of Items: 6	Physical Science	Life Science	Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade P(p). = page(s) Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
TEST ELIGIBLE CONTENT	a. Describe the relationships among DNA, genes, and chromosomes. b. Describe in basic terms the structure and function of DNA. c. Define the genetic purpose for meiosis from generation to generation. d. Define and distinguish between dominant and recessive genes and know how each is expressed in parents and offspring.											Gr. 8 – p. 92 Bio. – p. 118			______ ______ ______ ______

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ALABAMA HIGH SCHOOL GRADUATION EXAM
SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

STANDARD V. The student will understand concepts of cells.	Physical Science	Life Science	Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade P(p). = page(s) Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 1. Distinguish relationships among cell structures, functions, and organization in living organisms. Number of Items: 14														
TEST ELIGIBLE CONTENT a. Define and identify representations of diffusion and osmotic systems and what substances are transported by these processes. This may include graphic representations.											Gr. 7 – p. 82 Bio. – p. 119			______
b. Recognize differences between active and passive transport of substances and the energy requirements associated with these transport systems.														______
c. Identify and define similarities and differences between plant and animal cells.														______
d. Classify organisms as prokaryotic or eukaryotic; identify and define similarities and differences between prokaryotic and eukaryotic cells.														______
e. Describe cell locomotion by means of cilia and flagella and recognize some organisms that depend on one or the other of these means of locomotion.														______
f. Identify cell organelles and define functions of cell organelles. This may include graphic representations.														______
g. Distinguish and identify examples of cellular organization at the cell, tissue, organ, system, and organism level.														______
OBJ. 2. Differentiate between mitosis and meiosis. Number of Items: 4														
TEST ELIGIBLE CONTENT a. Define, contrast, and compare mitosis and meiosis. This may include events needed to prepare the cell for these processes.											Bio. – p. 119			______
b. Describe the purpose of mitotic and meiotic divisions during different life stages of organisms such as asexual and sexual reproduction and growth and repair.														______

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ALABAMA HIGH SCHOOL GRADUATION EXAM
SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

STANDARD VI The student will understand concepts of interdependence.

OBJ. 1	Physical Science	Life Science	Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade Pp. = pages Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
Demonstrate an understanding of factors that affect the dynamic equilibrium of populations and ecosystems. Number of Items: 7														
TEST ELIGIBLE CONTENT														
a. Describe the harmful/beneficial consequences of introducing a non-native species into an ecosystem.											Gr. 7 – p. 82, p. 83			______
b. Identify species that are competing for resources and predict outcomes of that competition.											Gr. 8 – p. 93			______
c. Identify and define biotic and abiotic components of different environments.											Bio. – p. 117, p. 120			______
d. Determine how viruses, bacteria, and parasites affect the dynamic equilibrium of populations.														______
e. Identify human activities that affect the dynamic equilibrium of populations and ecosystems.														______
f. Identify factors and relationships, such as predator/prey, that affect population dynamics and ecosystems.														______
g. Explain why diversity within a species is important and how heritable traits ensure survival.														______

STANDARD VII The student will understand concepts of energy.

OBJ. 1.	Physical Science	Life Science	Biology	Anatomy & Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade Pp. = pages Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
Relate the Law of Conservation of Energy to energy transformations. Number of Items: 4														
TEST ELIGIBLE CONTENT														
a. Describe how energy--mechanical, electrical, chemical, light, sound, and heat--can be transformed from one form to another.											Gr. 7 – pp. 81- 82			______
b. Show understanding that energy transformations result in no net gain or loss of energy; but that in energy conversions, less energy is available due to heat loss during the transformations.														______
c. Apply the concept of conservation and transformation of energy within and between organisms and the environment such as food chains, food webs, and energy pyramids.														______

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ALABAMA HIGH SCHOOL GRADUATION EXAM
SCIENCE STANDARDS, OBJECTIVES, and ELIGIBLE CONTENT - GRADES 7 – 12

STANDARD VII:	The student will understand concepts of energy. (cont.)	Physical Science	Life Science	Biology	Anatomy & Physiology	Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade Pp. = pages Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 2.	Relate waves to the transfer of energy. Number of Items: 4															
TEST ELIGIBLE CONTENT	a. Relate wavelength to energy. b. Describe how waves travel through different kinds of media. c. Describe how waves--earthquake waves, sound waves, water waves, and electromagnetic waves--can be destructive/beneficial due to the transfer of energy.												Gr. 7 – p. 81			______ ______ ______

STANDARD VIII:	The student will understand concepts of force and motion.	Physical Science	Life Science	Biology	Anatomy & Physiology	Physiology	Ecology	Chemistry	Physics	Physical Science	Earth Science		Course of Study Eligible Content Found in Course of Study Pages Gr. = grade Pp. = pages Bio. = Biology	Content Material	Date Taught	Date Competency Assessed
OBJ. 1.	Relate Newton's three laws of motion to real-world applications. Number of Items: 4															
OBJ. 2.	Relate force to pressure in fluids. Number of Items: 4															
TEST ELIGIBLE CONTENT	a. Relate force to pressure in fluids. (Note: Formulas will be provided, where needed, to calculate fluid force in closed systems.) b. Apply the concept of fluid pressure to biological systems such as in strokes, aneurysms, the bends, blood pressure, lung function, equalization of pressure on the eardrum, and turgor pressure.												Gr. 8 – pp. 91-92			______ ______

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READING COMPREHENSION CONNECTION: SCIENCE

Below you will find a list of the reading comprehension standards and objectives from the document, *Standards and Objectives (Reading Comprehension, Language, Mathematics, and Science) for Alabama High School Graduation Exam,* Bulletin 1997, No. 16. This list is intended as a reference for the reading comprehension connections identified in the science labs and activities within the document.

STANDARD I: **The student will demonstrate literal understanding of passages taken from textual, functional, and recreational reading material.**

1. Identify supporting details.
2. Determine sequence of events.
3. Follow directions.

STANDARD II: **The student will interpret passages taken from textual, functional, and recreational reading material.**

1. Identify main idea.
2. Draw conclusions.
3. Determine cause and effect.
4. Detect propaganda; distinguish fact from opinion.
5. Recognize statements that adequately summarize a passage.

STANDARD III: **The student will apply critical analysis strategies and judge texts critically to comprehend passages from textual, functional, and recreational reading material.**

1. Recognize fallacies of logic and judge strength of argument.
2. Analyze literary elements.
3. Demonstrate understanding of figurative language and analogy.

STANDARD IV: **The student will utilize strategies that enhance comprehension of textual, functional, and recreational reading material.**

1. Determine word meaning through the use of context clues.
2. Demonstrate the ability to preview and predict.
3. Discern organizational patterns.
4. Demonstrate the ability to locate information in reference material.

How Can Teachers Most Effectively Use This Science Document?

- Become familiar with the **entire** document. Pay careful attention to Standards, Objectives, and Eligible Content.

- Refer to this document when preparing lesson plans and remediating students.

- For each AHSGE Standard and Objective detailed in this document, read carefully to determine the content standards and related skills from the Course of Study that should be covered in the courses being taught.

- Be aware that the Standards, Objectives, and related skills may range from Grade 8 through Grade 12. Responsibilities do not rest just with high school teachers. A major share of the responsibility also belongs to middle and elementary school teachers.

- Use the activities appropriately.

  - Activities from the document may be used as a part of the instructional plan for teaching prerequisite skills and/or examination objectives. Other activities may be used as needed.

  - Adapt the activities to the age, grade level, and/or instructional needs of students.

  - Be aware that some activities should be used to introduce concepts or allow for discovery of concepts while others are more specifically designed to cover content. (Some activities are fairly advanced.)

  - Be aware that activities for each Objective (under each Standard) are included, but they do not cover all eligible content items. These activities alone are not designed to provide all the teaching and practice needed to help students master the content of the AHSGE. Read the Standards and Objectives carefully to identify all content that students are expected to know.

Instructional Strategies and Techniques
What Should Teachers Do?

Teachers can enhance students' chances for success by…

- Teaching all the content specified in the *Alabama Course of Study: Science,* Bulletin 1995, No. 4, for each course or grade level.
- Teaching students **HOW TO** take notes, organize material, study, and take tests (test-taking tactics).
- Having materials such as the state Course of Study, local curriculum guides, the Stanford 9 Compendium Supplement, supplementary materials that accompany textbooks, and other resources available as plans are developed for instruction and assessment.
- Attending staff development sessions on instructional assistance and ways to use supporting documents (Standards, Courses of Study, etc.).
- Providing guided and independent practice.
- Providing hands-on activities and other opportunities for active learning experiences.
- Providing assessments that are directly linked to instruction.
- Considering the different learning styles of students as plans are made for instruction.
- Using students' prior knowledge to strengthen their understanding.
- Making science relevant.
- Stressing vocabulary.
- Providing activities that reach all modalities: auditory, kinesthetic, visual, tactile.
- Providing intervention strategies.
- Using student self-assessment.
- Providing opportunities for cooperative and group learning.

Suggestions for Preparing and/or Remediating Students for Success on the *Alabama High School Graduation Exam* (AHSGE)

To prepare students better, school administrators should…

- Provide the faculty with a list of all students scheduled to take or retake the science subject-area test of the graduation examination.

- Provide more professional development opportunities for teachers.

- Solicit postsecondary and business involvement in after-school and summer tutorial programs.

The role of teachers in preparing and/or remediating students is to…

- Teach all the content specified in the *Alabama Course of Study: Science*, Bulletin 1995, No. 4, for each course or grade level.

- Use previous assessments to profile students' academic strengths and weaknesses. (Grades 8 - 10 Stanford 9 individual reports, Grade 7 writing assessments, and pre-graduation exam individual reports could be used for this purpose.)

- Analyze SAT group reports to evaluate curriculum and instruction.

  - Are there gaps in the program?
  - Is more emphasis needed in some areas?
  - Does the sequence of concepts need to be changed?

- Provide opportunities for students who are not mastering material to use tutorial software.

- Use a computer management system to record student progress.

- Develop practice tests written in the same format as the graduation examination and include appropriate practice items on teacher-made tests throughout the year.

- Create practice problems on each objective to assist with practice and mastery of the specific objectives.

- Use a variety of instructional techniques to teach all students.

To make sure students are adequately prepared for the graduation examination, they should...

- Form peer tutoring groups to assist each other in preparation for the test.
- Use their student report of the pre-graduation examination and/or the graduation examination results to set goals for improvement on their next test opportunity.
- Think about more than one way to solve a problem. (Use one method to solve and another method to check.)
- Avoid unnecessary absences from school.
- Become calculator- and computer-literate.
- Always ask for help before test time and complete all homework assignments promptly.
- Take responsibility for their own learning.

Parents can help if they...

- Make sure their children attend school every day possible.
- Make sure their children are completing homework assignments daily and are going to class prepared.
- Encourage their children to seek additional help when they experience difficulty mastering specific concepts.
- Require students to study and prepare adequately for the test.
- Request information on test content from school representatives.

To provide additional help, communities can...

- Establish mentoring programs to assist students in preparing for the test.
- Publicize *Alabama High School Graduation Exam* information.

Motivational Ideas

To increase motivation, students should have the opportunity to…

- Experience the world of science.
- Become actively involved in the learning process.
- Work with others on science labs, projects, or other classroom activities.
- Explore relationships among different science topics and among science and other subject areas.
- Use technology such as calculators and computers.
- Discuss science.
- Seek the applicability of science concepts to common and complex problems through explorations, videos, magazine articles, and open-ended problems.
- Contribute ideas to the classroom.
- Praise themselves as well as others.

The teacher's role in motivation is to…

- Set high expectations for **all** students.
- Develop lesson plans that include the learning objective, an interesting opening activity, essential vocabulary, extra help with difficult concepts, a brief summary, and a clearly stated assignment.
- Be enthusiastic during instruction.
- Provide practice time for learning new material or learning to use new equipment.
- Provide a classroom environment conducive to learning and one that encourages students to ask questions, take risks, and learn from their mistakes.

- Provide positive reinforcement for student behavior and/or achievement such as homework passes, incentive points, and improvement points.

- Create interest in science through competitions, labwork, projects, field trips, games, guest speakers, and other activities.

- Provide different modes of instruction that emphasize problem-solving, applications, and thinking processes. (Using cooperative learning or student pairing, incorporating manipulatives, models or laboratory equipment, and integrating calculators or computers on a regular basis should increase the effectiveness of instruction.)

- Avoid giving *busy* work during class time or for homework.

- Develop good questioning techniques. (Avoid questions that have one-word answers.)

- Provide frequent feedback.

- Be a coach, a mentor, and a facilitator.

School administrators may increase student motivation through…

- Academic pep rallies led by community leaders.

- Recognition and awards programs. (Rewards could include certificates, food, T-shirts, passes to school events, bumper stickers, and similar items.)

- Discussion of personal and schoolwide assessment results with students.

- Staff development activities.

- Curriculum evaluation and revision.

C. ACTIVITIES: SCIENCE

Producers - Consumers - Decomposers

(Teacher Notes)

Standard-Objective-Eligible Content: II-1, a (See pages B-2 - B-10.)

Lab Time: 60 minutes

Background: See student handout.

Materials: See student handout.

Pre-activity:
Discuss the definition and role of producers, consumers, and decomposers in an ecosystem. Tell students that the word autotroph means "self-feeder" in Latin and that the word heterotroph means "other feeder" in Latin. Collect magazine pictures of different ecosystems or have students bring them from home. These could be used in place of provided pictures or as further study.

Activity:
Put students in cooperative groups. Give students Figure 1. and discuss the roles of the producers, consumers, and decomposers in the ecosystem. Give students an unlabeled picture of an ecosystem (Figure 2. or magazine pictures) and tell them to identify individually the producers with a green-colored marker, the consumers with a blue-colored marker, and the decomposers with a red-colored marker. Check the drawings to make sure the students understand what to do.
Have students draw a picture of one of the following: a forest scene, a desert scene, an ocean scene, or a scene from their own community. Tell them to include the producers, consumers, and decomposers that would be found in that ecosystem. Display the drawings in the classroom. Each student should answer the questions.

Student Questions and Answers:

1. What are three organisms considered to be producers? *Pine tree, fruit trees, grasses, vegetable plants, rose bushes, etc.*
2. Why are producers important in an ecosystem? *Producers use energy from the sun to produce food and oxygen for all other organisms.*
3. What are three different organisms considered to be consumers? *Horses, dogs, cats, cows, humans, birds, fish, snakes, insects*
4. What purpose(s) do consumers serve in an ecosystem? *Consumers control populations of other organisms; they also return carbon dioxide and nutrients to the environment that the producers need to produce food.*
5. What are three different organisms considered to be decomposers? *Bacteria, fungi, some insect larva, and insects.*
6. What two things that would happen to an ecosystem if no decomposers were present? *Very few nutrients would be returned to the environment. Dead organisms would not be broken down and would continue to pile up in the ecosystem.*
7. What does the word autotroph mean in Latin? *Self-feeder*
8. What does the word heterotroph mean in Latin? *Other feeder*

Extension:
Have students select either producers, consumers, or decomposers and write a one-page report discussing the role that group plays in the ecosystem and telling what would happen if that group was greatly reduced in the ecosystem. The teacher may want to assign particular ecosystems and groups to each student or have him/her draw for the ecosystem and group.

Reading Comprehension Connection: II-2 and 3, IV-2 (See page B-11.)

Resources:
Books:

Arms, Karen. *Environmental Sciences*. Holt, Rinehart and Winston, 1996. pp. 55-61.
Miller, Kenneth R. and Joseph Levine. *Biology*. Prentice Hall, 1993. p. 15.
Person, Jane L. *Environmental Science*. LaBel Enterprises, 1989. pp. 29-30.

Producers - Consumers - Decomposers
(Student Handout)

Purpose: To define and identify producers, consumers, and decomposers

Background:
All ecosystems have organisms that can be classified as producers, consumers, and decomposers. Producers, also known as autotrophs, are organisms that produce their own food using the sun as a source of energy. Consumers, also known as heterotrophs, are organisms that get energy by eating other organisms. Decomposers, also known as heterotrophs, are organisms that break down dead organisms in an ecosystem and return the nutrients to the soil or water.

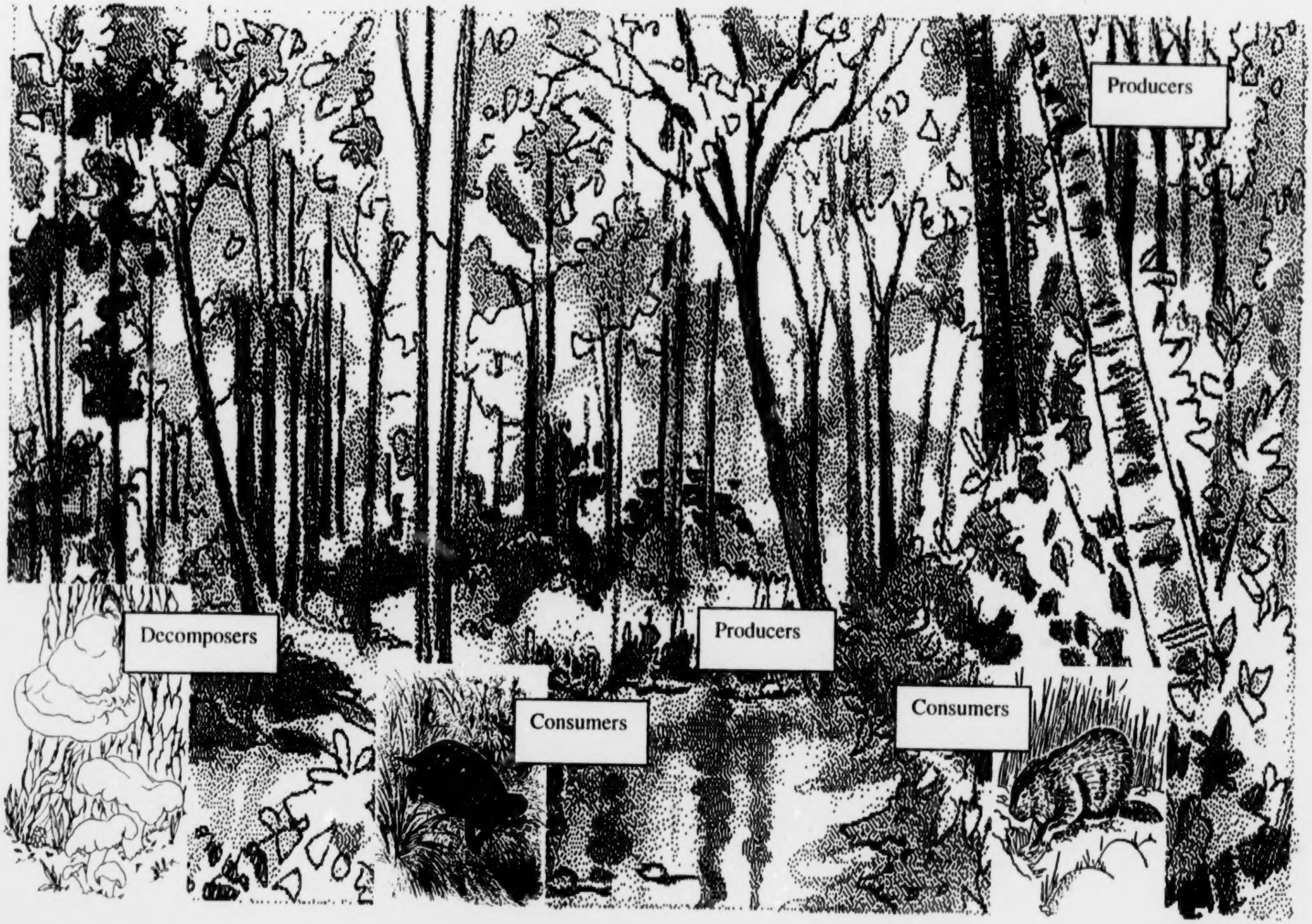
Materials:
Pictures with producers, consumers, and decomposers combined into a scene
Red-, blue-, and green-colored markers
Butcher block paper

Safety Considerations: Always follow lab safety procedures.

Procedure:
1. Define:
   Producer –
   Consumer –
   Decomposer –
2. Discuss in groups the importance of producers, consumers, and decomposers within an ecosystem.
3. Identify the producers, consumers, and decomposers in each picture.
   a. Circle the producers with a green-colored marker.
   b. Circle the consumers with a blue-colored marker.
   c. Circle the decomposers with a red-colored marker.
4. As a group, draw a picture of one of the following: a forest scene, a desert scene, an ocean scene, or a scene from the community. Be sure to include all of the producers, consumers, and decomposers found in that ecosystem.
5. Display the drawings in the classroom.

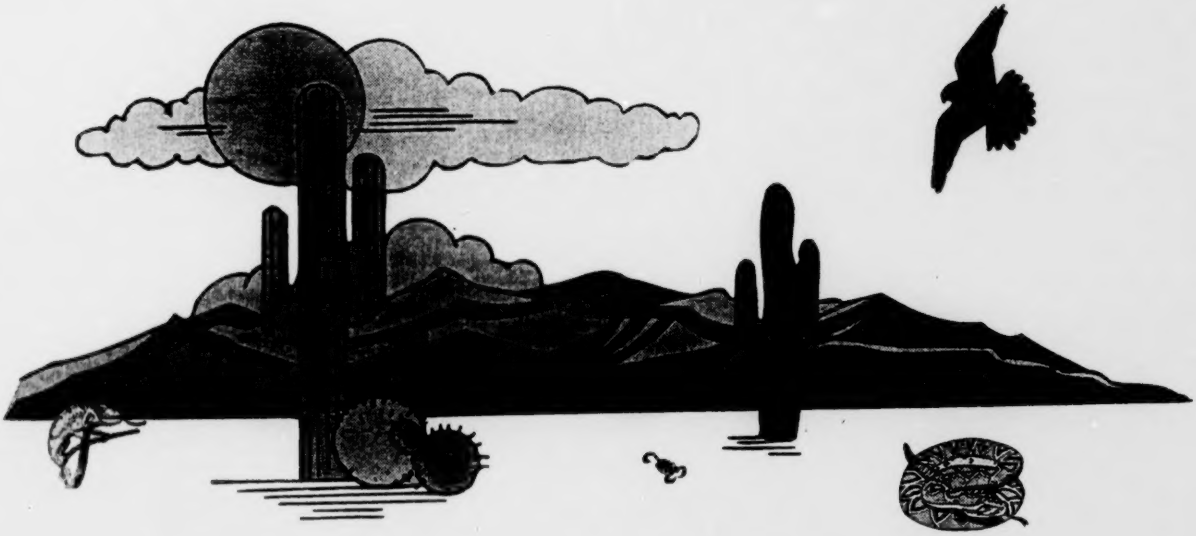
Questions:
1. What three organisms are considered to be producers?
2. Why are producers important in an ecosystem?
3. What three different organisms are considered to be consumers?
4. What purpose(s) do consumers serve in an ecosystem?
5. What three different organisms are considered to be decomposers?
6. What two things would happen to an ecosystem if no decomposers were present?
7. What does the word autotroph mean in Latin?
8. What does the word heterotroph mean in Latin?

Figure 1.


Producers
Decomposers
Producers
Consumers
Consumers

Producers **Consumers** **Decomposers**

Figure 2.



Pass the Energy Please
(Teacher Notes)

Standard-Objective-Eligible Content: II-1, b (See pages B-2 - B-10.)

Lab Time: 60 minutes

Background: See student handout.

Materials: See student handout.

Pre-Activity:
Demonstrate/visualize the concept of energy efficiency by leading a class discussion that illustrates an energy transfer process. For example, ask students to determine the number of kilowatt-hours of electricity they would receive if the efficiency of transfer in the following flow were only 10%:

10,000 kWh from a power plant→ transformer→ home→ student's room→ student's computer

The resulting 1 kWh available for the student's use will introduce the concept of energy flow through a system.

Activity:
Circulate among groups as the students trace the flow of energy through the aquatic ecosystem provided. Determine their understanding of trophic assignments and energy efficiency.

Post-Activity: Have group discussion of additional questions.

Student Questions and Answers:

1. Why are there fewer consumers at the top of the energy pyramid? *There are fewer consumers at the top of the pyramid due to the loss of energy from one trophic level to another.*
2. What role does the sun play in the ecosystem? *The sun is the essential source of energy for producers.*
3. Why is energy lost between feeding levels? *Ninety percent of potential energy is lost in moving from one trophic level to another. This loss is due to the heat expended in obtaining and digesting food, excreting waste, and maintaining body temperature for some organisms. This heat energy is dissipated to the environment and is considered lost because it is no longer useful to do work.*
4. Why are producers essential to the ecosystem? *Producers are essential to the ecosystem because they convert the sun's energy into a form that can be used by other organisms (i. e. food in the form of sugars and carbohydrates).*

Additional Questions and Answers:

1. Compare the trophic level of the killer whale when it feeds on the penguin to the elephant seal. *The killer whale is either secondary or tertiary when feeding on the penguin but always quaternary when feeding upon the elephant seal.*
2. What level of consumer would have the greatest population in the ecosystem? Explain why. *Primary consumers. They feed directly upon the producers where the greatest amount of energy is available.*

Extension:

List organisms in a familiar ecosystem (i.e., a meadow, vacant lot, park, lake, stream, or river). Place them in their proper trophic levels and describe the energy changes between levels.

Reading Comprehension Connection: I-3, II-3; IV-2 and 3 (See page B-11.)

Resources:

Books:

Johnson, George B. and Peter H. Raven. *Biology, Principles and Exploration.* Holt, Rinehart and Winston, 1993. pp. 342-349.

-----. *Biology.* Mosby Yearbook. 1992. p. 497.

Miller, Kenneth R. and Joseph Levine. *Biology.* Prentice Hall, 1993. pp. 15-21.

Person, Jane L. *Environmental Science.* Label Enterprise, 1989. pp. 15-21.

Pass the Energy Please
(Student Handout)

Purpose: To trace the flow of energy through the energy pyramid, food chain, and food web

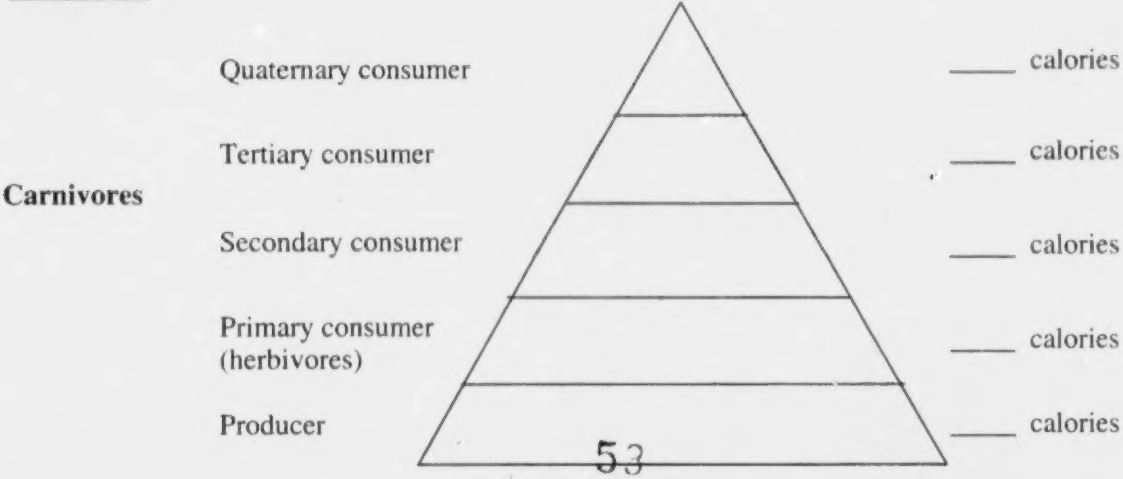
Background:
The sun is the ultimate source of energy for any ecosystem. Producers capture some of the light energy from the sun and transfer it into chemical energy as organic molecules (food). Energy is transferred through the ecosystem along trophic (feeding) levels. Each time energy is transferred, some is lost making less available at the next feeding level. Organisms use much of their energy to carry out life functions. This energy is converted to heat and lost so that only 10% of the energy is passed to the next level when one organism consumes another. A food chain is a simple sequence in which energy is transferred from one organism to another in an ecosystem. Ecosystems, however, are more complex and contain many more species. The food web is a more accurate illustration of energy transfer. Because of the energy lost, there are fewer organisms in each feeding level within the ecosystem.

Materials/Equipment:
Picture of energy pyramid, food chain, and food web

Safety Considerations: Always follow lab safety procedures.

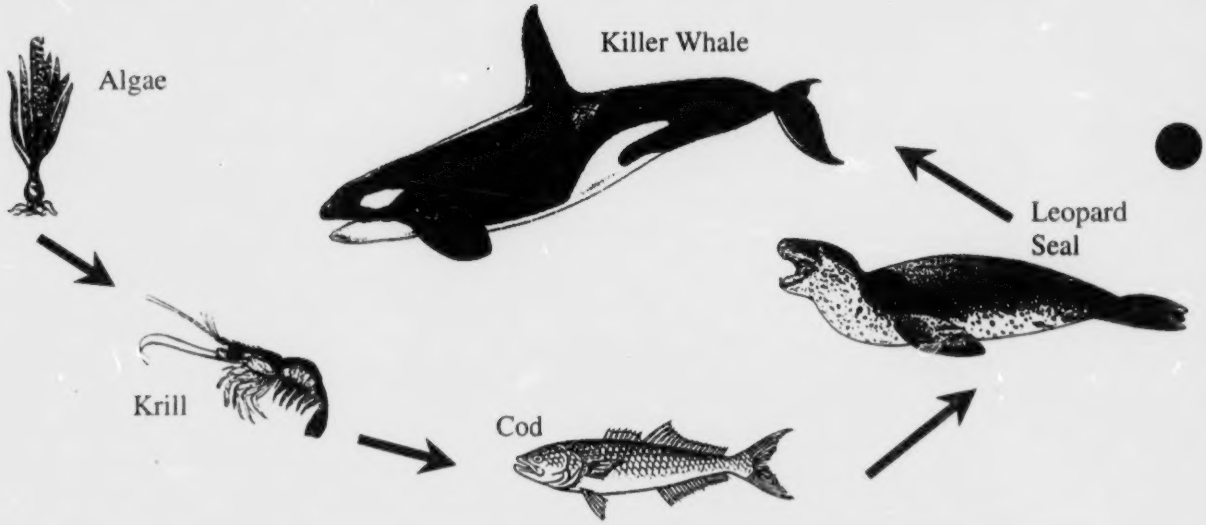
Procedure:
1. Examine sample food chain and food web.
2. Identify the trophic (feeding) levels by filling in the names of organisms in the blank energy pyramid, choosing any food chain from the food web. Be sure to start with the algae (water plants) as the producers at the lowest trophic level.
3. Determine the actual amount of energy transferred to the final consumer. Remember that the energy efficiency is about 10% from one trophic level to the next. Begin with the algae's trapping 1000 calories in organic molecules at the base of the food pyramid and figure the number of calories that would be available to each consumer. Remember: not all food chains will have organisms at all five trophic levels.

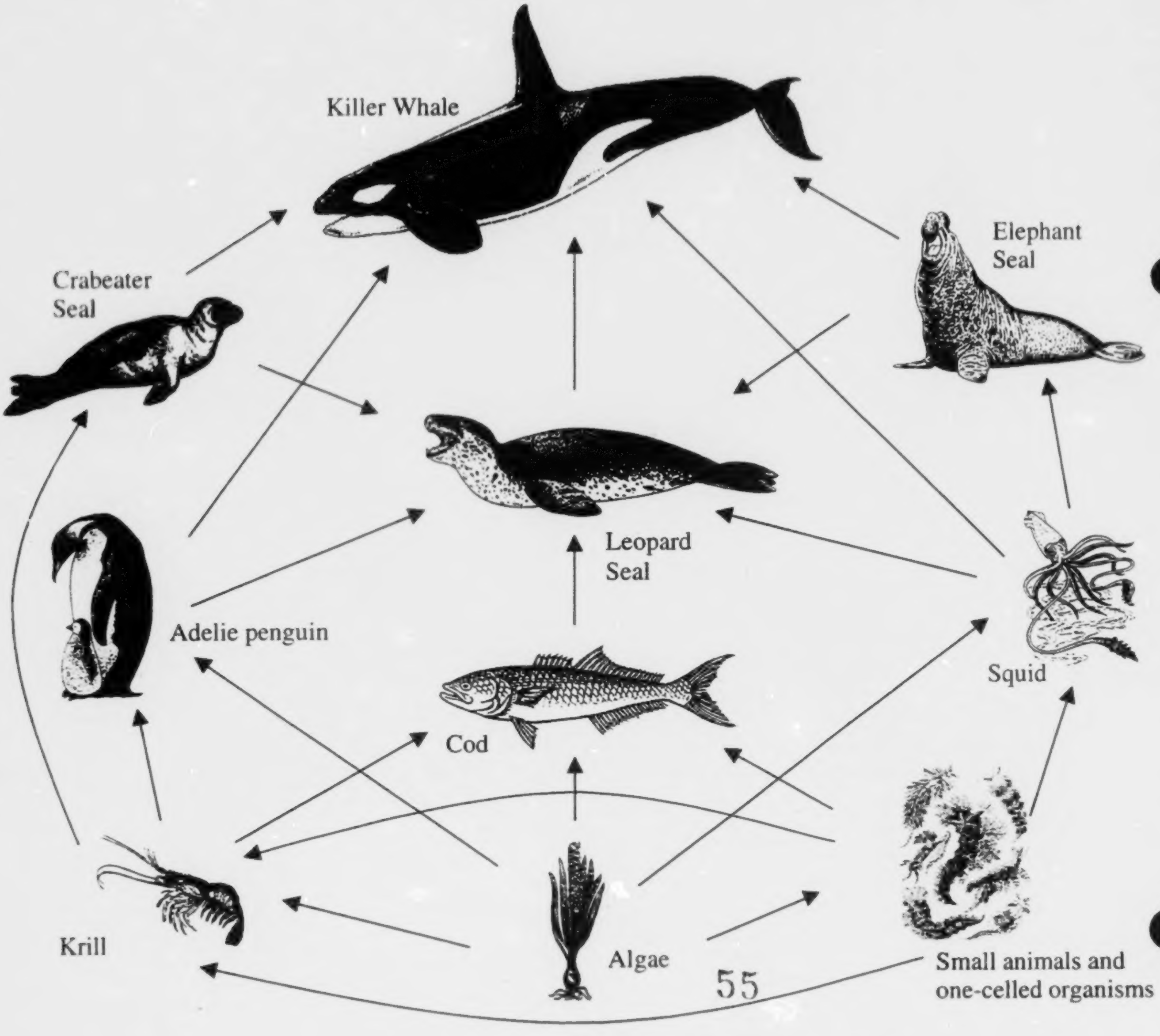
Data Table:



Questions:

1. Why are there fewer consumers at the top of the energy pyramid?
2. What role does the sun play in the ecosystem?
3. Why is there energy lost between feeding levels?
4. Why are producers essential to the ecosystem?


Algae
Killer Whale
Leopard Seal
Krill
Cod


Killer Whale
Crabeater Seal
Elephant Seal
Leopard Seal
Adelie penguin
Squid
Cod
Krill
Algae
Small animals and one-celled organisms

Bubbling Oxygen

(Teacher Notes)

Standard-Objective-Eligible Content: II-1, c and d (See pages B-2 - B-10.)

Lab Time: Three days: Day 1 - 55 minutes, Day 2 - 20 minutes, Day 3 - 20 minutes

Background: See student handout.

Materials: See student handout.

Pre-Activity:

Discuss with the class the processes of photosynthesis and cellular respiration. Be sure to cover the basic equation for photosynthesis: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ (in the presence of sunlight and chlorophyll).

Activity:

After 24 hours, students should see tiny bubbles of oxygen on the plant in the sun or in the upper end of the test tube and no bubbles on the set-up in the dark. On Day 3, test for oxygen as a demonstration for the students. To do so, remove the test tube while holding it in an inverted position. Unplug the stopper allowing the water to drain out of the test tube. Thrust a glowing splint into the test tube. The glowing splint should glow brighter or burst into flame if oxygen is present. Follow this same procedure for the set-up from the dark. Students should record their observation. CAUTION SHOULD BE EXERCISED HERE!

Post-Activity:

Students will write the equations for photosynthesis and cellular respiration on their student handouts. They also will write a word equation for both of these processes. Have students describe their observations from Day 2 and Day 3. They should explain the differences in their observations and in the results of the test for oxygen.

Student Questions and Answers:

1. What are the reactants and products of photosynthesis and cellular respiration? *Photosynthesis uses carbon dioxide and water in the presence of light to produce glucose and oxygen. Cellular respiration uses glucose and oxygen to produce carbon dioxide, water, and energy.*
2. What are the purposes of these two processes? *Photosynthesis produces food in the form of glucose. Cellular respiration releases the energy in the glucose molecule so those organisms can use it for all life functions.*
3. What are the equations for photosynthesis and cellular respiration?
   Photosynthesis: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
   Respiration: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy (ATP)}$
4. What are the differences in the two tests for oxygen and why was there a difference? *The splint glowed brighter or burst into flame in the presence of oxygen and remained the same or went out when no oxygen was present.*

Additional Questions:

1. What would happen if most of the world's photosynthesizing plants died out? Explain your answer.
2. What happens to the water produced by respiration? Hint: Breath on a cold glass.
3. What happens to some of the carbon dioxide released by respiration?
4. Draw a carbon cycle showing several places a carbon atom could go.

Extensions:

Discuss the importance of photosynthesis in producing food and oxygen for all living things, the cyclic relationship between photosynthesis and respiration, and the connection between this and food webs. Explore other cycles in nature such as the nitrogen cycle.

Reading Comprehension Connection: I-1, I-2, I-3, II-2, II-3 (See page B-11.)

Resources:

Books:

Miller, Kenneth R. and Joseph Levine. *Biology*. Prentice Hall, 1993. p. 115.
Person, Jane L., *Environmental Science*, LaBel Enterprises, 1989. pp. 29-32.

Internet:

Access Excellence High School Biology site
http://www.gene.com/ae/AE/AEC/AEF/1995/kolb_biotech.html
http://www.gene.com/ae/AE/AEC/AEF/1995/jensen_respiration.html
http://www.gene.com/ae/AE/AEC/AEF/1995/goodman_respiration.html
http://www.gene.com/ae/AE/AEC/AEF/1996/morishita_pictures.html
http://www.gene.com/ae/AE/AEC/AEF/1995/allard_voyage.html

Bubbling Oxygen

(Student Handout)

Purpose: To identify the reactants and products associated with photosynthesis and cellular respiration and to know the purpose of these two processes

Background:

The cycle of photosynthesis and respiration maintains the Earth's natural balance of carbon dioxide and oxygen. Green plants, using the sun as their energy source, take in carbon dioxide from the atmosphere and water from both the soil and atmosphere. They use these materials to produce food (sugar) and oxygen. All of our food come either directly or indirectly from this energy-converting process. Plants and animals burn the food by combining it with oxygen to release energy for growth and life activities. This process is called respiration and is the reverse of photosynthesis. Oxygen is used and carbon dioxide and water are given off.

Materials:

2 water plants (such as Elodea)
2 rubber stoppers
Bottled water

2 test tubes
2 test-tube racks
Wax pencil

Safety Considerations: Always follow lab safety procedures. Wear goggles during the lab.

Procedure:

1. Students are to fill two test tubes full of bottled water.
2. Place a water plant in test tubes and close tubes with a rubber stopper so that no water can leak out.
3. Invert the test tubes and place one on each rack.
4. Place one in the sun and the other in a dark place. Leave for 24 hours.
5. After 24 hours, students should observe both set-ups and record their observations.
6. Repeat Step 5 for the next two days.

Data Table: Observations:

Time	Observations
24 hours	
48 hours	
72 hours	

Questions:

1. What are the reactants and products of photosynthesis and cellular respiration?
2. What is the purpose of these two processes?
3. What is the equation for photosynthesis and cellular respiration?
4. What are the differences in the two tests for oxygen and why was there a difference?

Cycles of Nature
(Teacher Notes)

Standard-Objective-Eligible Content: II-1, d (See pages B-2 - B-10.)

Lab Time: 60 minutes

Background: See student handout.

Materials: See student handout.

Pre-Activity: (15 minutes)
Direct students to read about the carbon-oxygen, nitrogen, and water cycles. Tell students to relate what they have read to the diagrams on page C-16 of the three cycles. Discuss the cycles and their importance.

Activity: (25 minutes)
Divide into small groups. Each group will draw original illustrations of the three cycles using organisms (biotic) and nonliving things (abiotic) in the local community.

Post-Activity: (20 minutes)
Small groups will share illustrations with the class and ask other groups to answer their questions. Provide a place for students to display their illustrations. Teacher may wish to incorporate student questions into a test or worksheet covering the three cycles.

Reading Comprehension Connection: I-2 (See page B-11.)

Resources:

Books:

Arms, Karen. *Environmental Sciences*. Holt, Rinehart Winston, 1996.
Miller, Kenneth R. and Joseph Levine. *Biology*. Prentice Hall, 1993.
Person, Jane L. *Environmental Science*. LaBel Enterprises, 1989.

Cycles of Nature

(Student Handout)

Purpose: To identify and apply knowledge about the carbon-oxygen, nitrogen, and water cycles

Background:
Water is not lost; it just moves from place to place. We call this movement between the atmosphere and the Earth the water cycle. Producers take in carbon in the form of carbon dioxide during photosynthesis. It is then passed to the consumers as they eat. When the consumer's cells break down food to release energy (respiration), carbon is passed back into the atmosphere as carbon dioxide. Oxygen is also involved in this cycle. Producers release oxygen during photosynthesis and consumers use it during respiration. Nitrogen passes back and forth between the atmosphere and living things. Bacteria and fungi (decomposers) break down dead organic matter and wastes to return the nitrogen to the soil in the form of ammonia. In the soil, nitrogen-fixing bacteria transform it into both nitrogen gas that returns to the atmosphere and nitrates that can be utilized by plants.

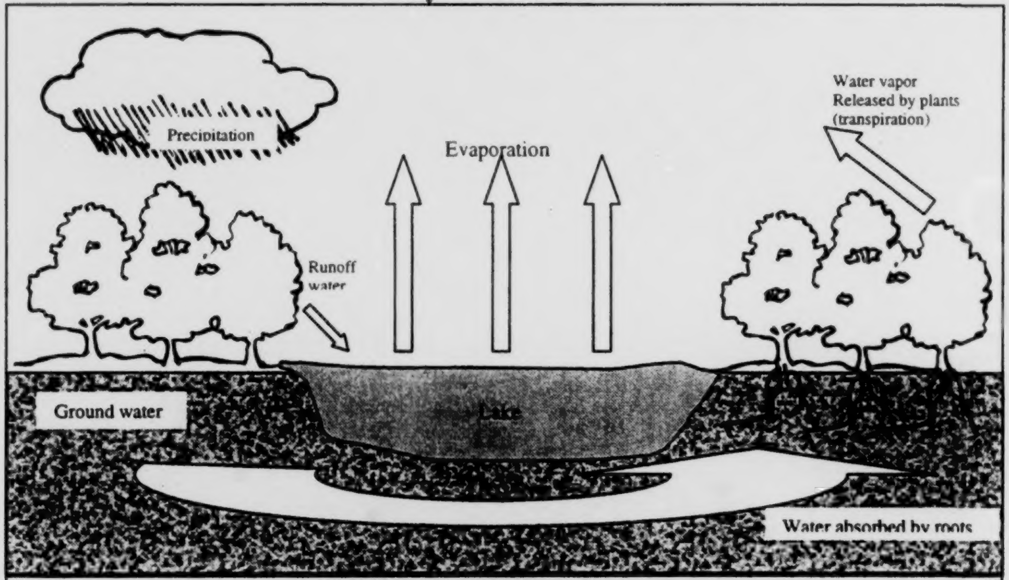
Materials:

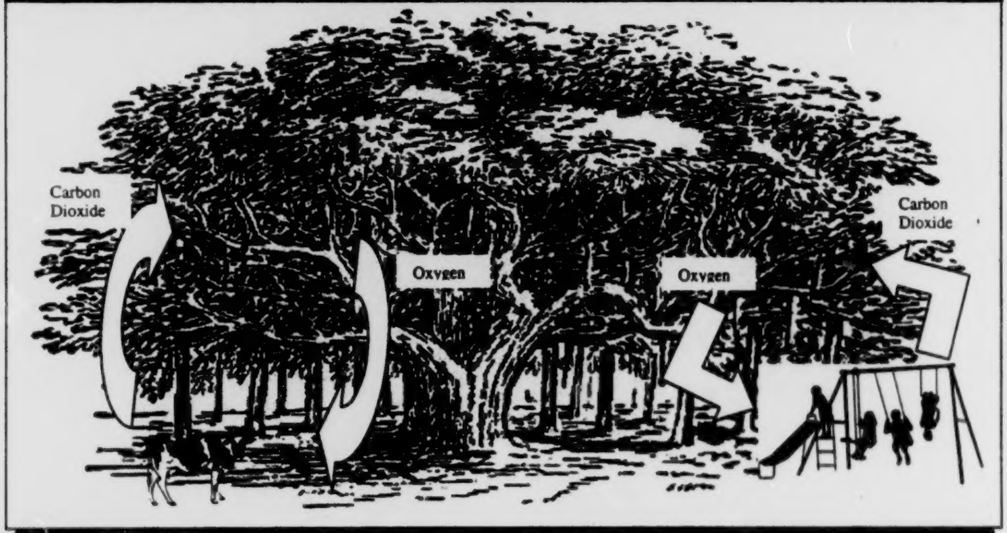
Illustrations of each cycle	Poster board or butcher block paper
Textbook with explanation of the cycles	Colored markers

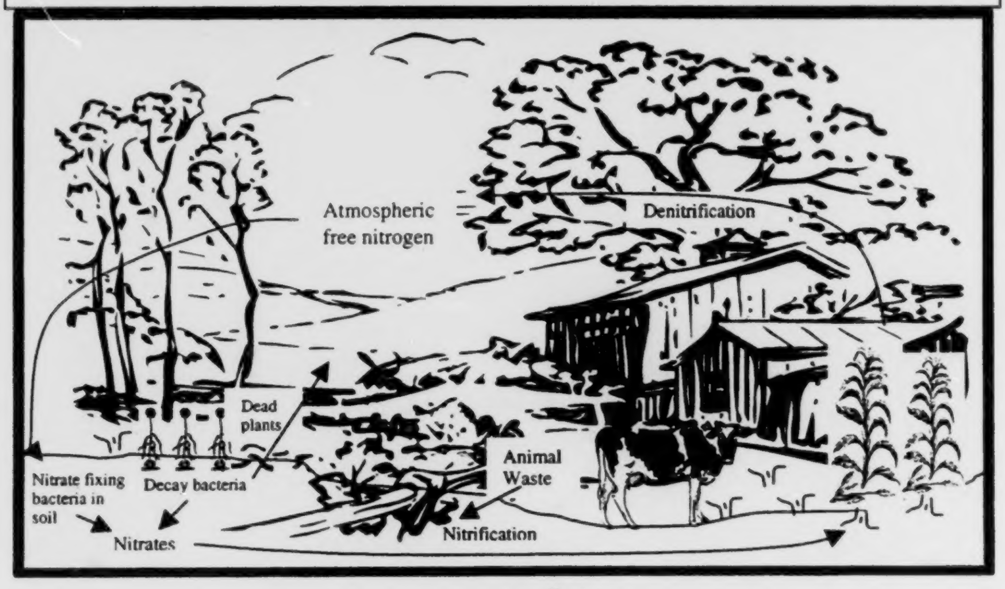
Safety Considerations: Always follow lab safety procedures.

Procedure:
1. Divide into small groups.
2. Using various resources containing illustrations of each of the three cycles, draw and color an illustration of each cycle using organisms from the community.
3. Write three questions pertaining to each of the three cycles for the class to answer.
4. Be prepared to discuss your group's drawings and questions with the class.

Cycles of Nature


Precipitation
Evaporation
Water vapor
Released by plants
(transpiration)
Runoff
water
Ground water
Lake
Water absorbed by roots


Carbon
Dioxide
Oxygen
Oxygen
Carbon
Dioxide


Atmospheric
free nitrogen
Denitrification
Dead
plants
Animal
Waste
Nitrate fixing
bacteria in
soil
Decay bacteria
Nitrates
Nitrification

Molecular Matters
(Teacher Notes)

Standard-Objective-Eligible Content: II-2, a (See pages B-2 - B-10.)

Lab Time: 50 minutes

Background: See student handout.

Pre-Activity Materials: (per group)

Three 250-mL beakers
Food coloring
Thermometer
200 mL cold water
200 mL room-temperature water
200 mL hot water

Materials: See student handout

Pre-Activity: (10 minutes)

1. Divide the students into groups of four.
2. Give each group three beakers. One beaker should contain cold water, the second beaker should contain room-temperature water, and the third beaker should contain hot water.
3. Give each group a container of food coloring. Tell the students they must design an experiment to show a relationship between temperature and the movement of the molecules in the beakers of water.
4. The students should share their ideas with the class.
5. Most of the groups will decide to place a drop of food coloring in each beaker and observe how the temperature of the water affects the movement of the molecules of the food-coloring. They will note that, as the temperature of the water increases, the movement of the food coloring particles will also increase.

Activity:

Suggested liquid ice-cream solution: Mix two 14-oz. cans of sweetened condensed milk and two liters of orange soda. The students should place 250 mL of the ice-cream solution in the plastic sandwich bag. The students should mix 500 mL of ice and 50mL of salt in the quart-size plastic bag. The small bag containing the ice-cream solution should be placed in the large plastic bag of ice and salt. Make sure the small bag is sealed tightly and is positioned upright. Check for leaks. If the salt solution enters the small bag, the ice-cream solution will not freeze. The students should use the thermometer to record the initial temperature in the ice and salt bag. The students in the group should take turns kneading the ice-cream solution bag in the ice/salt solution bag. They should continue to knead the solutions in the bags until a solid forms in the small bag. They should record the time and temperature in two-minute intervals. The students should also record other changes (water condensation and ice forming outside the large bag, ice crystals forming inside the small bag).

Post-Activity:

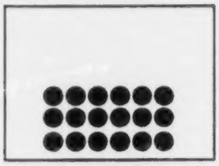
The students should design an experiment to demonstrate how an increase of energy will alter the movement of the particles. They can devise ways to change a solid to a liquid or a liquid to a gas.

Sample Data and Observations:

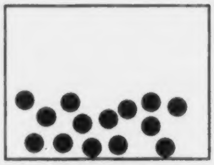
Time (minutes)	Ice/salt solution temperature	Small Bag Observations	Large Bag Observations
0			
2			
4			
6			
8			
10			

Student Questions and Answers:

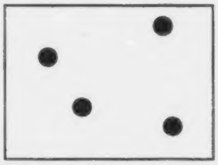
1. Describe the changes of temperature in the ice/salt bag. *The temperature gradually decreased. The temperature should drop below 0° C.*
2. How did the conditions in and around the plastic bags change during the experiment? *Answers will vary: ice crystals should form in the small bag; water vapor should condense outside the large bag, and eventually ice crystals will form on the bag's surface.*
3. Relate the results of this experiment to changes in molecular movement and kinetic energy. *When the energy decreased, the molecular movement decreased.*
4. Did the state of matter change in the small plastic bag during the experiment? *Explain the results. Answers will vary. The liquid solution should change to a solid.*
5. List the states of matter indicating the state of matter with the highest kinetic energy and the lowest kinetic energy. *The states of matter from highest kinetic energy to lowest are: gas, liquid, solid.*
6. Density refers to the amount of mass per volume. Which state of matter (solid, liquid, or gas) has the highest density? *Use the boxes below to illustrate answers. Use dots (●) to represent the particles of matter (solid, liquid, gas).*



Solid



Liquid



Gas

Extensions:

Students could define the following terms: condensation, evaporation, and sublimation. Students could write paragraphs that relate these terms to changes in states of matter. Students could work in cooperative groups and demonstrate examples of condensation, evaporation, and sublimation to their classmates. The students could investigate how salt affects the density and freezing point of water.

Reading Comprehension Connection: I-3, II-2, II-3, (See page B-11.)

Resources:

Books:

Bilash II, Borislaw. *A Demo A Day*. Flinn Scientific, 1997. pp. 25-26.

Maton, Anthea, et al. *Exploring Physical Science*. Prentice Hall, 1995. pp. 62-75.

Internet:

Annenberg/CPB - Science and Math Initiatives and the Teacher Help Service

http://www.learner.org/sami/

Classroom Connect home page

http://www.classroom.com

The Exploratorium - water phase changes and hockey

http://www.exploratorium.edu/hockey/skating1.html

Molecular Matters
(Student Handout)

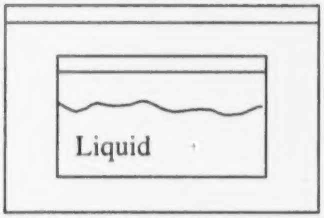
Purpose: To relate particle motion to the states of matter

Background:
All matter is in constant motion. As the temperature increases, so does the rate of motion. Although solids have a definite shape and volume, each molecule of the solid vibrates in all directions. As the temperature of the solid increases, so do the vibrations. When the temperature reaches the melting point, the force of attraction is insufficient to hold the particles together in the solid state. The solid becomes a liquid. Liquids have a definite volume. However, a liquid does not have a definite shape. When the temperature of the liquid increases, the movement of its molecules also increases. If the liquid's temperature reaches the boiling point, the space between the molecules will continue to increase. The kinetic energy increases to the point where there is not enough attraction to hold the molecules in the liquid state. The liquid becomes a gas.

Materials: (per group)
500 mL crushed ice
50 mL salt
250 mL liquid ice-cream solution
Beakers
Plastic sandwich bag with a zipper seal
Quart-size plastic freezer bag with a zipper seal
Thermometer
Cups

Safety Considerations: Always follow lab safety procedures.

Procedure:



1. Place orange liquid solution in the small plastic bag. Make sure the bag is sealed tightly.
2. Mix 500 mL of ice and 50 mL of salt in the large plastic bag.
3. Place the small bag containing the orange solution in the large plastic bag of ice and salt.
4. Knead the small bag inside the large bag of ice and salt.
5. Using the second columns of the chart, record the temperature of the ice and salt solution in two-minute intervals. Continue to knead and record temperatures until a solid forms in the small plastic bag.
6. Record other observations in the third and fourth columns of the chart.

Data Table:

Time (minutes)	Ice/salt solution temperature	Small Bag Observations	Large Bag Observations
0			
2			
4			
6			
8			
10			

Questions:

1. Describe the changes of temperature in the ice/salt bag.
2. How did the conditions in and around the plastic bags change during the experiment?
3. Relate the results of this experiment to changes in molecular movement and kinetic energy.
4. Did the state of matter change in the small plastic bag during the experiment? Explain the results.
5. List the states of matter indicating the state of matter with the highest kinetic energy and the lowest kinetic energy.
6. Density refers to the amount of mass per volume. Which state of matter (solid, liquid, or gas) has the highest density? Use the boxes below to illustrate the answers. Use dots (●) to represent the particles of matter (solid, liquid, gas).

Periodic Table Bingo

(Teacher Notes)

Standard-Objective-Eligible Content: II-3, a-c (See pages B-2 - B-10.)

Lab Time: 30-60 minutes. (Time is determined by difficulty of the information given about the elements and the pattern that is used to determine the winner.)

Background: See student handout.

Materials: See student handout.

Pre-Activity:

Run off copies of the game grid. Choose common elements, which have characteristics that have been previously discussed, or that should be reinforced during the activity. These might include all 92 naturally occurring elements or 30 to 40 of those considered important. The teacher may wish to use an additional assignment the day prior to "Periodic Table Bingo" by passing out 3 x 5 inch index cards, one to each student, with specific instructions to return the cards with symbol, atomic number, and atomic mass shown on one side. On a piece of paper, students should record general research information found on one assigned element. Using the information table on page C-25, make up questions on each element to be used during the activity. These should be recorded on the reverse of the index Clue Card for that element and laminated for future use. Periodic Tables of the Elements should be obtained and laminated for use during the game. The questions asked should reflect the Course of Study objectives and level of the student. Hand out grids to the students. Ask them to **fill** in only the symbols of the common elements. They may be asked to do this randomly or with certain columns or rows containing specific information (i.e., Column I could be noble gases; Column II, nonmetals; Column III, transition metals; Column IV, light metals; and Column V, metalloids). The students should be encouraged to choose their own elements randomly because if they duplicate the chart of other students, there will be no way to determine a winner. Make sure the symbols chosen correspond to cards/questions prepared beforehand.

Activity:

Have students clear their desks of all but a Bingo Card and a Periodic Table of Elements. Shuffle the Clue Cards and place them in a container. Choose the pattern that will be formed to produce the winner (i.e., one column or row, an "X" diagonally, or even the whole card covered). Draw the information cards randomly. Read all or part of the information/questions on the Clue Card. The game could be as simple as reading the name and/or atomic number of the element chosen or as demanding as requiring specific information in answer to questions about the oxidation number, classification, charge of ion formed, or examples of compounds formed by the element. Allow the students time to determine if that symbol is found on their cards and mark it. Students will **"Bingo"** when they cover the appropriate pattern. Some reward should be given to the winner.

Student Questions and Answers:

1. Determine the "atomic number" and "atomic mass" for each of the first 20 elements on the Periodic Table of Elements. *See the Key for the Periodic Table of Elements used.*
2. How many protons, electrons, and neutrons are contained in the first 20 elements? *See Periodic Table. Example: Chlorine - atomic number: 17, rounded atomic mass: 35. Number of protons and electrons is the same as the atomic number, so chlorine has 17 protons and 17 electrons. The difference between the atomic number and the atomic mass is 18 (35-17), so its most common isotope has 18 neutrons.*
3. Identify each element and determine whether it would be classified as a metal, nonmetal, metalloid, or noble gas. What patterns/trends do you recognize as you move consecutively from element 1 to element 20?
   Metals: Lithium, Sodium, Potassium, Beryllium, Magnesium, and Calcium
   Nonmetals: Carbon, Nitrogen, Phosphorus, Oxygen, Sulfur, Fluorine, and Chlorine
   Metalloids: Hydrogen, Boron, Aluminum, and Silicon
   Noble Gases: Helium, Neon, and Argon
   As one moves from Element I (Hydrogen) to Element 20 (Calcium) consecutively, one goes from metal to metalloid to nonmetal to noble gas (Elements 3-10); and the pattern repeats for Elements 11-18. This periodicity is the basis for the organization of the Periodic Table of Elements.
4. Determine the number of outer shell or valence electrons contained in each atom for elements 1-20.
   The number in parenthesis is the number of outer shell electrons for each element listed.
   Metals: Lithium (1), Sodium (1), Potassium (l), Beryllium (2), Magnesium (2), and Calcium (2)
   Nonmetals: Carbon (4), Nitrogen (5), Phosphorus (5), Oxygen (6), Sulfur (6), Fluorine (7), Chlorine (7)
   Metalloids: Hydrogen (1), Boron (3), Aluminum (3), and Silicon (4)
   Noble Gases: Helium (2), Neon (8), and Argon (8)
5. Predict the ionic charge of each element, 1-20, that would have one. Explain why you decided not to assign an ionic charge to some elements.
   True metals and nonmetals tend to react ionically with each other under normal conditions and exhibit ionic charges. Nonmetals and metalloids tend to form binary compounds with each other that are more covalent in nature.
   Metals: Lithium (1+), Sodium (1+), Potassium(1+), Beryllium (2+), Magnesium(2+), and Calcium (2+)
   Nonmetals: Nitrogen (3-), Phosphorus (3-), Oxygen (2-), Sulfur (2-), Fluorine (1-), and Chlorine (1-)

Additional Questions:

1. Select two elements on the Periodic Table of Elements that exhibit somewhat similar characteristics and discuss why you think they do.
2. Select an element on the chart that would make a good partner in a compound with copper.

Extensions:

1. Expand this activity to include many periodic trends and properties related to periodicity of the elements.

2. Have students do historical research on the discovery of patterns and trends in the elements that led to Mendeleyev's organization of the Periodic Table.

Reading Comprehension Connection: IV-1 and 2 (See page B-11.)

Resources:

Books:

Abraham, Michael, Donna Coshow, and William Fix. *ChemSource, Volume 3. "Periodicity."* ChemSource, Inc., (American Chemical Society at 1-800-209-04230). 1994. pp. 45-65.

Internet:

Yinon Bentor's interactive periodic table of elements
http://www.chemicalelements.com

Software:

Atoms and Elements. CASL Technologies. Order # QU 124 (DOS) or QU 126 (Mac)

Video/Multimedia:

Discover the Elements CD. CASL Technologies. Order # SW4WCD (Windows) or SW4MCD (Mac).

The Periodic Table: Reactions and Relationships. CASL Technologies. Order # 10487VE

Periodic Table of Elements

Name	Symbol	Atomic Number	Atomic Mass	Clue
Hydrogen	H	1	1	The lightest element, contains only a single proton, can lose or gain only 1 electron
Helium	He	2	4	The lightest noble gas, filled outer shell with only two electrons, named for the Greek word for sun because first discovered in spectral analysis of sunlight
Lithium	Li	3	7	Active alkali metal from Group I with three protons, forms 1^+ ions in a salt
Beryllium	Be	4	9	Alkaline earth metal with four protons used in forming strong lightweight alloys with copper
Boron	B	5	11	Metalloid in Group III combines with silicates to form heat-resistant glassware, forms acid used in eardrops and as a pesticide
Carbon	C	6	12	Basis for all organic chemicals, essential for life as we know it on earth, element with four outer-shell electrons that undergo sp^3 hybridization to form four bonding orbitals with tetrahedral structure
Silicon	Si	14	28	The second most abundant element in the Earth's crust; a metalloid with four outer shell electrons used in solar cells, microprocessor chips, and ceramics
Germanium	Ge	32	73	Group IV metalloid used in doping computer chips and transistors
Nitrogen	N	7	14	Most abundant element in the Earth's atmosphere, an element that is relatively non-reactive at normal temperatures, essential for protein formation in living tissues
Phosphorus	P	15	31	Group V element with three allotropes: white that reacts with air at 30°C and red that is less active; element that is essential to strong root development in plants; element used in fertilizers, explosives, and detergents
Arsenic	As	33	75	Poisonous Group V metalloid used in making semiconductors and in pesticides
Oxygen	O	8	16	Most abundant element on Earth making up 48% of the Earth's crust, atmosphere, and surface water; highly reactive element that supports combustion with many other substances; essential for respiration in most living organisms; ozone is a common allotrope; six outer shell electrons cause it to form 2^- ions
Sulfur	S	16	32	Common Group VI element with 3 different allotropic forms, widely used in industry as a component of sulfuric acid, used as a dehydrating agent in paints and plastics
Selenium	Se	34	79	Metalloid in Group VI used in making photocells

Fluorine	F	9	19	Most reactive nonmetal that is never found free in nature. Member of Group VII, the halogen family; forms 1^- ions; organic compounds containing this element are used as nonstick cookware and refrigerants; forms compounds used to prevent tooth decay
Chlorine	Cl	17	35	Halogen used as a bleaching agent, component of common table salt, used as a disinfectant and water purifier
Bromine	Br	35	80	Halogen, which is a brownish liquid at room temperature, used in medicines, dyes, and photography
Iodine	I	53	127	Halogen used as a disinfectant, in photography and as a salt additive that prevents goiter
Neon	Ne	10	20	Inert gas in Group VIII which produces a red glow in lights.
Argon	Ar	18	40	Noble gas used in welding active metals, denser than air
Krypton	Kr	36	84	An inert element which produces a whitish glow in lights..
Xenon	Xe	54	131	First noble gas to form a compound by stripping away electrons, used in photographic lamps
Radon	Rn	86	222	Radioactive noble gas used in treating cancer, can collect in some buildings producing a health hazard
Sodium	Na	11	23	Highly reactive alkali metal of Group I that forms 1^+ ions and reacts violently with water, never found free in nature and reacts violently with Chlorine of the halogen family to form common table salt, required in the body for proper transmission of nerve impulses
Potassium	K	19	39	Highly reactive member of Group I that reacts violently in water and is required to allow proper transmission of nerve impulses
Cesium	Cs	55	133	Highly reactive Group I metal that is a liquid at warm room temperature (28.5°C), silvery white metal used in making photocells
Rubidium	Rb	37	85	Soft lustrous metal with one electron in its outer shell, reacts violently with moisture, used in spacecraft engines and photocells
Francium	Fr	87	223	Extremely rare radioactive Group I metal, contains 136 neutrons and only 87 protons
Magnesium	Mg	12	24	Lightweight member of the alkaline Earth metals of Group II, forms 2^+ ions, reacts slowly with water and rapidly with steam, used in making lightweight alloys, found in hydroxide compounds used as antacids
Calcium	Ca	20	40	Alkaline earth metal found commonly in the Earth's crust, a limestone used in making cement or concrete, often found in pipes or boilers as a result of hard water, forms 2^+ ions
Barium	Ba	56	137	Massive Group II element, a radioisotope of which is used as a radioactive tracer in medicine
Radium	Ra	88	226	Radioactive Group II element used to treat cancer and in medical research

Aluminum	Al	13	27	Lightweight metal that forms 3^+ ions, the third most abundant element in the Earth's crust, more valuable than gold or silver prior to development (1886) of the Hall Perot process for extracting it from bauxite
Tin	Sn	50	119	Stable metal used in making cans, forms 2^+ and 4^+ ions, alloy with copper forms bronze
Lead	Pb	82	207	Stable metal once used for plumbing, symbol comes from Latin name *plumbum*, forms 2^+ and 4^+ ions.
Titanium	Ti	22	48	Light transition metal used in making strong lightweight alloys, oxidation numbers 4^+ and 3^+
Chromium	Cr	24	52	Shiny transition metal used in electroplating steel, oxidation numbers 6^+, 3^+ and 2^+
Manganese	Mn	25	55	Transition metal used and catalyst for oxidation-reduction reactions; oxidation numbers 7^+, 6^+, 4^+, 3^+ and 2^+, used in making alloys
Iron	Fe	26	56	Fourth most abundant element in the Earth's crust; used in manufacturing, building materials, and dietary supplements; oxidation numbers 3^+ and 2^+; main component of steel
Cobalt	Co	27	59	Transition metal used to make alloys used to make magnets and heat-resistant tools, oxidation numbers 2^+ and 3^+, often used to make blue pigment for paints
Nickel	Ni	28	59	Transition metal used in making coins, batteries, jewelry, and electroplating; oxidation numbers 2^+ and 3^+
Copper	Cu	29	64	Transition metal used in cooking utensils, wiring, plumbing and electric motors; oxidation numbers 2^+ and 1^+
Silver	Ag	47	108	Shiny lustrous metal; best conductor of heat and electricity; oxidation number 1^+; used in jewelry, ornaments, mirror backing, and dental fillings
Gold	Au	79	197	Valuable metal used as base for many money systems; used in jewelry, coins, and dentistry; oxidation numbers 3^+ and 1^+
Cadmium	Cd	48	112	Transition metal used to make yellow pigments in paint, electroplating, batteries, and as control rods in nuclear reactors
Mercury	Hg	80	201	Toxic transition metal, which is a liquid at room temperature; used in thermometers, barometers, electric switches, and paint pigments; alloy with silver that produces dental amalgam
Platinum	Pt	78	195	Transition metal used as catalyst, in electronics, lab ware, and jewelry
Tungsten	W	74	184	Transition metal used in making light-bulb filaments and alloys with high density and high melting point
Vanadium	V	23	51	Transition metal used to make shock resistant steel and used as catalyst
Zinc	Zn	30	65	Transition metal used to galvanize iron, forms alloy with copper called brass, used in dry cell batteries, oxidation number 2^+
Uranium	U	92	238	Radioactive member of the actinide series used as fuel in nuclear reactors, heaviest natural element

Periodic Table Bingo

(Student Handout)

Purpose: To utilize the periodic table in determining the number of electrons, protons, and neutrons for an atom; determining the number of outer shell electrons; predicting possible ionic charges for elements; and recognizing metals, nonmetals, metalloids, and noble gases.

Background:

The Periodic Table is the source of a great deal of information about chemical elements. The key can tell the location of the atomic number and atomic mass on a chart. The atomic number tells the number of electrons and protons, while the difference of the rounded atomic mass and atomic number gives the number of neutrons in the most common isotope of the element. Metals are generally found on the bottom left of the Periodic Table [most metallic at the bottom of Group 1 (IA)]. Nonmetals are generally found on the top right of the Periodic Table, excluding the farthest right Group [the most nonmetallic element is fluorine, at top of Group 17 (VIIA)]. Metalloids are generally clustered around and touching the zigzag line that runs diagonally in a stair-step fashion starting to the left of Boron [Group 13 (IIIA)]. All noble gases are located on the far right of the chart in Group 18 (VIIIA). For "A" Groups, the number of outer shell electrons is always the Group number. If there are three or fewer electrons, the atom will tend to lose them if an ionic reaction occurs and become positively charged. If there are five or more electrons in the outer shell, the atom tends to gain electrons if an ionic reaction occurs and become a negatively charged ion. The closer two elements are on the Periodic Table of Elements, the less likely they are to react ionically. Noble gases do not form compounds under normal conditions. Such properties as atomic and ionic radius, size, electronegativity, ionization energy, and toxicity can be predicted from patterns on the Periodic Table.

Materials:

Periodic Table Bingo Card
Small coins
Clue Cards
Colored pieces of paper or plastic discs
Periodic Table of Elements
Clue Card container

Procedure:

Obtain a Periodic Table Bingo Card. Choose elements and **fill** in the symbols of the elements on the card as directed by the teacher. Listen to the information about the element given on the chosen Clue Card. Determine if that element is on the card and place a coin, piece of paper, or disc on the indicated symbol. The winner will **bingo** when he/she has marked the correct pattern of elements on the bingo card.

Questions:

1. Determine the "atomic number" and "atomic mass" for each of the first 20 elements on the Periodic Table of Elements.
2. How many protons, electrons, and neutrons are contained in the first 20 elements?
3. Identify each element and determine whether it would be classified as a metal, nonmetal, metalloid, or noble gas. What patterns/trends do you recognize as you move consecutively from element 1 to element 20?
4. Determine the number of outer shell or valence electrons contained in each atom for elements 1-20.
5. Predict the ionic charge of each element, 1-20, that would have one. Explain the decision not to assign an ionic charge to some elements.

Periodic Table Bingo Card

Bubble The Trouble Away
(Teacher Notes)

Standard-Objective-Eligible Content: II-4, a (See pages B-2 - B-10.)

Lab Time: 50-60 minutes

Background:
Chemical reactions make life possible. If these reactions proceed too slowly, the ordinary activities of life would come to a halt. A substance that can speed up that rate is called a catalyst. Catalysts work by lowering the "start up" or activation energy of a reaction and are not changed or used up themselves.

Living organisms contain their own special catalysts, which are proteins known as enzymes. An enzyme may accelerate a reaction by a factor of 10 to the 10th power, so that a reaction that might take 1500 years can be completed in a cell in just five seconds!

Enzymes speed up a reaction by binding to the substances that enter the reaction. These substrates bind to the enzymes at a region known as the active site. The way the reaction is catalyzed may occur because the enzyme holds two substances together in positions in which they can react with each other; or an enzyme can twist a substrate so that a chemical bond is broken, producing two smaller molecules. An enzyme's shape is so specific for that substrate that it can be compared to a lock and key. In fact, simple cells have as many as 2000 different enzymes, each to catalyze a different reaction!

Materials/Equipment: See student handout.
The 3% hydrogen peroxide and liver (chicken or beef) can be purchased at a grocery store. For investigating temperature influence, provide thermometers, ice, and boiling water. Provide lemon juice, ammonia, and wide-range pH paper to investigate pH as a factor. Other plant and animal tissues, such as fresh potato, apple, carrot, chicken meat, could be purchased to test the occurrences of catalase in various living tissues.

Pre-Activity: (15-20 minutes)
1. Divide into work groups and instruct teams to propose an answer for the question, "What would happen to your cells if they made a poisonous chemical?" List responses on the board.
2. Explain the role of enzymes in speeding up the breakdown of toxins by modeling enzyme activity with jigsaw-shaped pieces to represent the enzyme catalase and its substrate hydrogen peroxide. Display the "lock and key" nature. Write on the back of the jigsaw pieces: enzyme, substrate, and the area of active site.
3. Write the balanced equation for this reaction: $H_2O \rightarrow H_2O + O_2$. The word catalase belongs over the arrow in this reaction. Have students identify the substrate, the enzyme, and the products of this reaction.

Activity: (45 minutes)
1. Allow one team to gather materials for the activity while the other groups read the Background and Procedures.

2. Instruct the demo team to follow procedure in Steps 1-4 and make observations aloud for the class. Ask the class to devise a way to standardize their estimates of the bubbling activity (such as a scale of 0-5 with 5=greatest and 0=none), and to explain why such a scale would be important.
3. Refer to procedure Steps 3 through 4 in the Student Handout to discuss the concepts that enzymes are not altered by the reaction they participate in, i.e., are not "used up," and that catalase activity is exothermic in nature.
4. Guide groups to answer the questions.

__Designing the experiment:__ **(2 approaches)**

1. Ask groups to propose factors that would influence the rate of enzyme activity. Use guided questions to select one factor that the class will examine. As they decide how to approach the problem, assess their understanding of dependent and independent variables and a need for a control. Remind them to organize their observed data into comparison charts and graphs using the same rating scale as before.

OR

2. Choose from the suggested activities below to test influencing factors.
   A. What is the Effect of Temperature on Catalase Activity?
      1. Place a small piece of liver, covered with distilled water, in a boiling water bath (100C) for five minutes. Predict the effects on the enzyme.
      2. CAUTION: Carefully remove the test tube from hot water using tongs, allow it to cool, and pour off the water. Add 2 mL of 3% hydrogen peroxide and record the rate of reaction. Explain the results.
      3. Place equal quantities of liver into each of three test tubes and 2 mL of hydrogen peroxide into three others. Place a test tube of liver and one of hydrogen peroxide into each of the following: 0C (ice) water bath, 22C (room temperature), and 37C (warm water bath).
      4. After three minutes, pour the tube of hydrogen peroxide into the corresponding tube of liver for each temperature. Record the reaction rates for each.
      5. Make a graph of the reaction rates compared to temperature. What is the best (optimum) temperature for catalase activity?

   B. What is the Effect of pH on Catalase Activity?
      1. Measure and add 2 mL of hydrogen peroxide to each of three clean test tubes. Then to:
         Tube 1--add 10 drops of lemon juice (or 1N HCl) using stirring rod to mix.
         Tube 2--add 10 drops of ammonia (or 1N NaOH) using stirring rod to mix.
         Tube 3--add 2 drops of ammonia and 1 drop of lemon juice using stirring rod to mix.
      2. Determine pH with wide range pH paper or sensor. Record the pH number value for each tube.
      3. Add a small piece of liver to each test tube. Estimate and record the rates of reaction.
      4. Make a graph of estimated reaction rates compared to pH. At what pH does there appear to be a best reaction? What is the effect of low or high pH on enzyme activity?

__Sample Data and Calculations:__

Generally the temperature effect will show greatest activity around 30-37C then start dropping until there is no activity at 100C (protein enzymes are denatured and shape is changed at those settings).

The optimum pH for catalase activity is between pH 7 and pH 10 (slightly basic) with the lowest being in the acid range of pH 2-4. (High levels of hydrogen ion concentration -low pH- also tend to denature the protein conformation or alter the polarity of the molecules.)

At higher concentrations of hydrogen peroxide, there is a greater chance that an enzyme molecule will collide with this substrate.

1. Measure and place 2mL of the 3% hydrogen peroxide into a clean test tube or cup.
2. Using the forceps, add a small piece of liver to the test tube pushing it into the peroxide with the stirring rod.
3. Pour off that liquid into another test tube.
4. Add another 2 mL of the 3% hydrogen peroxide to the liver remaining in the test tube from Step 2.
5. What factors would influence the rate of this enzyme activity? Design an experiment to test that influence. Be sure to include materials, procedure, data table, and conclusions.

Student Questions and Answers:
1. Describe the peroxide. Is it bubbling? *colorless liquid, no bubbles*
2. What do you observe? Which product of this reaction is being released? *rapidly rising froth of bubbles, oxygen*
3. The liquid is now composed of what? What would happen if more liver were added to this liquid? Why? *water; nothing, the substrate has already been catalyzed*
4. Is there any reaction? Predict what would happen if this liquid were poured off and more hydrogen peroxide added to the liver again. *yes, more bubbles, predict same reaction every time since enzymes are not altered or used up in a reaction*
5. What factors would influence the rate of this enzyme activity? *Class discussion will vary depending on available materials and time frame.*

Additional Questions:
1. What other way could the products of this enzyme be identified? *(glowing splint for oxygen gas)*
2. What other way could the products of this enzyme be measured? *(pressure sensor for gas)*
3. What happens to the heat produced when this reaction occurs in living cells? *(generates body heat)*
4. Predict the effect of prolonged high body temperatures (fever).

Extensions:
Hydroxylamine is a competitive inhibitor of catalase that attaches to catalase and interferes with its normal binding with hydrogen peroxide. To test its effects, five drops of 5% hydroxylamine can be added to 2 mL of hydrogen peroxide before the piece of liver is introduced. Other extensions could include research into conditions and diseases associated with enzyme absence or malfunctions.

Reading Comprehension Connection: I-2, I-3 (See page B-11.)

Resources:

Internet:

Community College of Baltimore County, MD - Dr. Gary E. Kaiser-BIO 141 Microbiology Lab Manual

http://www.cat.cc.md.us/courses/bio141/labmanua/lab8/index.html

Access Excellence High School Biology - Computer Interfacing Experiments

http://outcast.gene.com/ae/21st/TE/PW/ciexp.html

Bubble The Trouble Away
(Student Handout)

Purpose: To examine the activity of an enzyme in living tissues

Background:
By the time a student can count down 5...4...3...2...1 seconds, an enzyme can complete a chemical reaction that normally might take 1500 years! In this activity, you will study one such enzyme called catalase. It is found in many living cells and can speed up the reaction that breaks down poisonous hydrogen peroxide into two harmless substances: water and oxygen. Since hydrogen peroxide is a by-product of so many normal cell activities, it must be quickly broken down or those cells would die. Beef- or chicken-liver cells will be used to demonstrate the activity of catalase. Even though these cells are actually no longer alive, their enzymes remain active for several weeks.

Materials/Equipment:
2mL 3% hydrogen peroxide
10 mL graduated cylinder (or small calibrated measure)
2 test tubes with rack (or small, clear containers)
Stirring rod
Forceps
Pea-sized piece of liver (chicken or beef)

Safety Considerations: Always wear goggles in lab. Use test tube holder for hot test tubes. Handle carefully. Be sure to clean stirring rod each time.

Procedure:
What is Normal Catalase Activity?
1. Measure and place 2mL of the 3% hydrogen peroxide into a clean test tube or cup. Describe the peroxide. Is it bubbling?
2. Using the forceps, add a small piece of liver to the test tube pushing it into the peroxide with the stirring rod. What do you observe? Which product of this reaction is being released?
3. Pour off that liquid into another test tube. What do you think the liquid is now composed of? What do you think would happen if you added more liver to this liquid? Why?
4. Add another 2 mL of the 3% hydrogen peroxide to the liver remaining in the test tube from Step 2. Do you observe any reaction? Predict what would happen if you poured off this liquid and added more hydrogen peroxide to the liver again.
5. What factors do you think would influence the rate of this enzyme activity? Design an experiment to test that influence. Be sure to include materials, procedure, data table, and conclusions.

Gymnosperms and Angiosperms

(Teacher Notes)

Standard - Objective - Eligible Content: III-2, b and c (See pages B-2 - B-10.)

Lab Time: Part A Gymnosperms - 30 minutes; Part B Angiosperms - 30 minutes

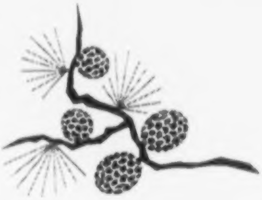
Background: See student handout.

Materials: See student handout.

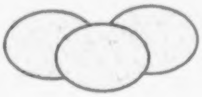
Sample Drawings:

Part A - Gymnosperms

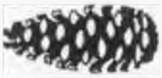
1. Draw a picture of the pollen cone in the space below.



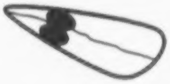
2. Observe the grains through the microscope and sketch them below. If a microscope is not available, use a magnifying glass.



3. Draw a picture of the seed cone below.



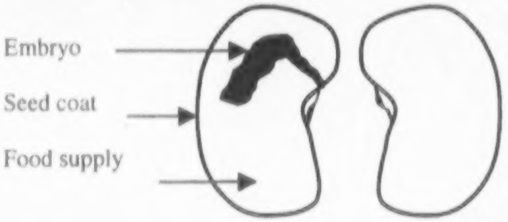
4. Observe the seed and scale and draw them below.



Part B - Angiosperms

1. Draw a picture of the bean from each view and color it with crayons or colored pencils.

2. Break the bean seed open. If it does not open easily, use a scalpel or scissors. Observe and identify the parts of the seed. Compare it to the diagram below.



Student Questions and Answers:

Part A - Gymnosperms

1. In nature, how does the pollen grain get to the seed cone? *wind pollination*
2. How does the shape of the pollen help with this process? *It has little wings on each side to help it fly in the wind.*
3. How does the shape of the seed relate to the way it is dispersed? *It is winged to help it fly in the wind.*
4. Is the seed enclosed in a fruit or is it naked (exposed). *naked*
5. Name three kinds of plants that are gymnosperms. *pine, redwood, spruce, fir or Ginkgo*

Part B - Angiosperms

1. Why is it advantageous for the seeds to be enclosed in a fruit? *a. protection, b. aids in seed dispersal (The fruit, seeds and all, is eaten by other organisms and leaves the digestive tract ready to grow. Also some fruits have barbs that attach to animal fur.), c. fruit decomposes and becomes nutrients for the plant.*
2. Name three fruits and the way they are dispersed. *a. Maple fruits – wind, b. Mulberry fruits – bird digestive tract, c. Cocklebur – animal fur*
3. Why is it an advantage for flowers to have such varied shapes, sizes, colors, and odors? *These are all used to attract animals that aid in pollination and seed dispersal.*
4. Fill in the following chart comparing gymnosperms to angiosperms. Check the box for the characteristics that apply.

Characteristics	Gymnosperms	Angiosperms
Naked seeds	X	
Seeds inside a fruit		X
Flowering plants		X
Produce cones	X	
Produce fruits		X
Wind Pollination	X	X
Insect Pollination		X

Examples	Gymnosperms	Angiosperms
Corn		X
Grasses		X
Ginkgo	X	
Rose		X
Pine	X	
Tomatoes		X
Apples		X
Redwood	X	

Reading Comprehension Connection: I-1-3; II-2 and 3; IV-2 (See page B-11.)

Resources:

Book:

Johnson, George B. and Peter H. Raven. *Biology Principles and Explorations.* Holt, Rinehart and Winston, pp. 530-340.

Internet:

Christopher J. Earle's - Gymnosperm Database

http://home.earthlink.net/~earlecj/

Encyclopædia Britannica, Inc - on-line search engine

http://www.eb.com/cgi-bin/g?keywords=

Gymnosperms and Angiosperms
(Student Handout)

Purpose: To observe and record differences in the seeds of two major groups of plants.

Materials: (Set up for every two students.)
1 male or pollen cone
1 female or seed cone (Try to use some that still contain seeds.)
1 pod with the beans or peas inside
1 microscope (If a microscope is not available, use a magnifying glass.)

Safety Considerations: Always follow lab safety procedures.

Part A - Gymnosperms
Background:
Both gymnosperms and angiosperms produce seeds. Gymnosperm means "naked seed," and the seeds are not encased in a fruit. Conifers such as pine trees, produce cones as you will observe in this lab. Spruce, redwood, fir, and ginkgo are all examples of gymnosperms. Most gymnosperms are evergreens with needlelike or scalelike leaves.

The pine tree produces two different types of cones. The pollen cone produces pollen that contains sperm cells. The pollen is carried by the wind and lands on the sticky female (seed) cone. It takes about 15 months for the pollen to unite with the egg cell in the female cone. An enormous amount of pollen is produced, and some of it lands on ovules. This yellow pollen can be seen on the sidewalks, puddles, and lakes in the springtime in Alabama.

Procedure:
1. Begin by observing the pollen cone. Describe the male cone. Some things to consider are size, texture, smell, shape, color, etc.

2. Draw a picture of the pollen cone in the space below.

3. Dust some of the pollen grains onto a microscope slide. Put a drop of water and a coverslip on it.

4. Observe the grains through the microscope and sketch them below. If a microscope is not available, use a magnifying glass.

5. Now observe the seed cone. Write a description of the seed cone including how the scales are arranged, their texture, shape, color, etc.

6. Draw a picture of the seed cone below.

7. Gently shake the cone. Remove one of the scales and examine its base. Perhaps some seeds will be present. However, even if they aren't, there are usually impressions of the seed on the scale.

8. Observe the seed and scale and draw them below.

Questions:

1. In nature, how does the pollen grain get to the seed cone?

2. How does the shape of the pollen help with this process?

3. How does the shape of the seed relate to the way it is dispersed?

4. Is the seed enclosed in a fruit, or is it naked (exposed)?

5. Name three kinds of plants that are gymnosperms.

Part B - Angiosperms

Background Information:

The word angiosperm means "flowering plants." This group of plants produce flowers and seeds encased in a fruit. Angiosperms make up the largest group of plants. They include grasses; corn; daisies; tomatoes; and apple, orange, and pear trees. These plants rely on many different insects, birds, and mammals for pollination. Some are self-pollinated or wind-pollinated. The fertilization of flowers and production of a seed take place quickly when compared to gymnosperms.

Procedure:

1. Observe the bean pod from the outside, then open it up, and examine it from the inside. Describe it in writing from each view.

Outside: Inside:

2. Draw a picture of the bean from each view and color it with crayons or colored pencils.

3. Break open the bean seed. If it does not open easily, use a scalpel or scissors. Observe and identify the parts of the seed. Compare it to the diagram below.

Questions:

1. Why is it advantageous for seeds to be enclosed in a fruit ?

2. Name three fruits and tell how the seeds of each are dispersed.

3. Why is it an advantage for flowers to have such varied shapes, sizes, colors, and odors ?

4. Fill in the following chart comparing gymnosperms to angiosperms. Check the box for the characteristics that apply.

Characteristics	Gymnosperms	Angiosperms
Naked seeds		
Seeds inside a fruit		
Flowering plants		
Produce cones		
Produce fruits		
Wind Pollination		
Insect Pollination		

Examples	Gymnosperms	Angiosperms
Corn		
Grasses		
Ginkgo		
Rose		
Pine		
Tomatoes		
Apples		
Redwood		

Create a Flower

(Teacher Notes)

Standard-Objective-Eligible Content: III-2, c and d (See pages B-2 - B-10.)

Lab Time: 105 minutes

Background: See student handout.

Materials/Equipment: See student handout.
Real lilies work best and can be obtained from a local florist. It may be necessary to substitute a real one with a silk flower.
Floral wire comes in two-foot cut lengths or in rolls. Walmart has both kinds, and it is inexpensive ($2.00 or so for enough to do several classes).
If only the large-sized sheets of white construction paper are available, cut them in half.

Pre-Activity: (15 minutes)
Have the students follow the instructions on the student handout to become familiar with the names and functions of the flower's reproductive structures.

Activity: (45 minutes)

1. Give each group two flowers. The teacher or a group leader will take one flower apart and give each student in the group one part to draw and color. Since the sepals and pistil are easier, give some students more than one of these if needed. The group will be responsible for drawing and coloring all of the parts of the lily. Keep the other lily in one piece so that students can see what it looks like all together.
2. As the students begin assembling their flowers, walk around and offer suggestions if needed. Usually they will observe each other and correct assembly problems.
3. Make sure that each group member gets a chance to name the parts and explain their functions.
4. Display them around the room. Since the wire will hold the flower's form, they can be put on the wall, ceiling, or anywhere.

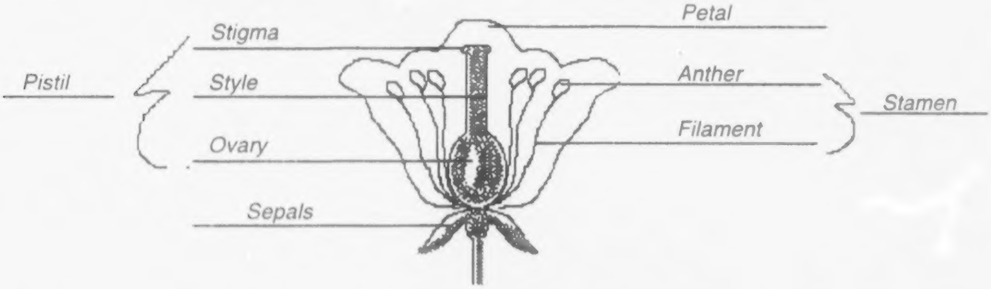
Post-Activity: (45 minutes)
Have the students write a short story about their journey through a flower. They can pretend they have shrunk and are crawling around inside, or they can be an insect closely examining each structure as they encounter it. They can include the weather condition, the mood they are in, the colors and textures they see, the nectar they smell. Where would this flower be best suited to live? (dry, wet, cold, warm, hot) Why would it need such an area? After students finish writing, they can read the short stories aloud.

Student Questions and Answers for Diagram:

1. Flower parts and their functions.

Sepals – *protect the petals before the flower opens*
Petals – *attract insects and birds*
Stamen – *male reproductive structure*
Anther – *contains the pollen*
Filament – *hold up the anther*
Pistil – *female reproductive structure*
Stigma – *sticky part that pollen sticks to*
Style – *long tube the pollen travels down*
Ovary – *contains the ovules that become seeds*

2. Label the parts of the flower below.



Reading Comprehension Connection: I-3, IV-4 (See page B-11.)

Resources:

Books:

Johnson, George B. and Peter H. Raven. *Biology Principles & Explorations.* Holt, Rinehart and Winston, 1996. pp. 536-537.

Create a Flower
(Student Handout)

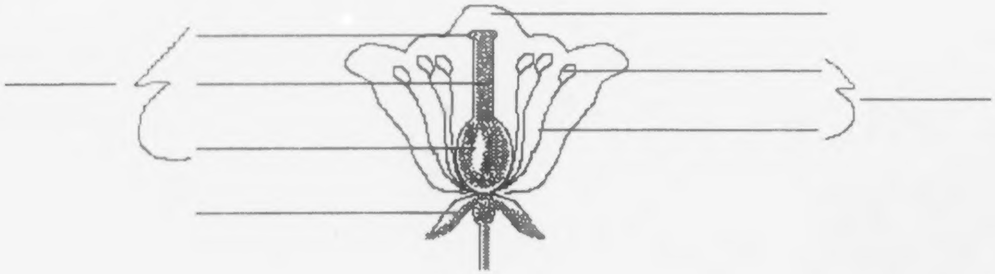
Purpose: To identify the names and functions of the parts of a flower

Background:
Angiosperms or flowering plants are the most modern type plants. They reproduce by producing flowers and seeds. (The seeds are enclosed in a structure.) Each part of the flower has an essential function. The reproductive organ in an angiosperm is the flower. Most flowers are complete and contain both the male and female reproductive parts. The flower shown below is a complete flower. Each flower part has a specific name and function.

1. Using the textbook or another source, write the function of each of the following flower parts.

Sepals ______________________________
Petals ______________________________
Stamen ______________________________
  Anther ______________________________
  Filament ______________________________
Pistil ______________________________
  Stigma ______________________________
  Style ______________________________
  Ovary ______________________________

2. Label the parts of the flower below.



Materials/Equipment:

2 lilies per group
1 piece of foam board per group (12" X 12")
Clear tape
Crayons for each student
Floral wire
White construction paper

Safety Considerations: Always follow lab safety procedures.

Procedure:

1. Divide into groups. Each group should have about six members.
2. The teacher will give each group a flower. Carefully take the flower apart so that each part can be seen. The group leader will give each member a flower part to draw and color. A few students may need to draw two parts. Color both sides of the structure. Make them as large as possible on the paper. Each petal should be about the same size as the others in the group. Notice the different shades, colors, and spots contained on each structure. Try not to leave any white spaces showing.
3. After finishing the coloring of the flower part, tape a piece of floral wire to the back of it with clear tape. Leave about three inches of wire sticking out of the bottom end of the structure.
4. Next, take a piece of cardboard or foam board, punch a small hole on the middle, and begin assembling the 3-D flower. Begin with the petals, then the stamen, and finally the pistil. Tape the wire under the cardboard as you go. When everything is taped in, bend the wire to make the flower petals, sepals, stamen, and pistil look more realistic.
5. Have each group member identify the reproductive structures of the flower and discuss their function.
6. Display the flowers in the classroom.

Questions:

1. Which part of the flower is considered the female reproductive structure?
2. Which part of the flower attracts insects?
3. What role do insects play in flower reproduction?
4. Why is the pistil sticky?
5. To what part of a flower are most people allergic?

A Grab For Grub

(Teacher Notes)

Standard-Objective-Eligible Content: I-1-a, e; III-3-b; VI-1-g (See pages B-2 - B-10.)

Lab Time: 90-120 minutes (1 to 2 class periods)

Background:
Because resources such as space, food, and mates are limited within a particular environment, individuals with slight differences that provide an advantage or adaptation will survive and reproduce better than others. These differences are inherited in sexual reproduction on chromosomes in the sex cells of each parent. A special form of cell division called meiosis produces these sex cells. During meiosis, several opportunities occur for genetic traits to be altered resulting in new combinations or diversity in the offspring. If environmental conditions favor these mutations, they also tend to be passed on to future generations, and those organisms have an advantage for increasing in number. Without this diversity among individuals, environmental pressures could decrease numbers or eliminate entire populations.

Materials: See student handout.
Mix four different-sized "foods" in a shallow container, one for each group. Assorted sizes of beans and pasta, bird seed, rice, raisins are suggested. Each group will need a set of laminated "food cards" naming each of the four foods in a food cup. Sets of four different "beaks" should also be prepared for each group. Suggestions are straws, toothpicks, tweezers/forceps, clothespins, plastic spoons, scoopulas. Each student will need a "grub cup." This can be a plastic or paper drinking cup. Each student will need a sheet of paper to place grabbed grub on for counting and storage until it is added into the feeding container. The "Scribe" or "Recorder" will need a journal to record the group members' results. Be sure to announce the penalty of grabbing "wrong" grub before beginning the activity.

Pre-Activity:
Distribute the following to cooperative learning groups: carrots, pecans, lettuce, and apples. Direct the "Performer" in the group to bite and chew each of the items, while the other students observe and relay their comments describing the process for each item to the "Scribe" for recording. After all groups have finished, have them discuss findings within each group, looking for any similarities and differences. After all groups have come to consensus, ask each group to report findings and conclusions. Student reports should note that different teeth were used to bite and chew the different foods. Ask, "Why do you think you could not eat carrots only with incisors or apples only with molars?" Discuss the relationship between food consumption and "eating parts." Ask, "Would a bird's having a deformed beak have any effect on whether or not it survived?" Proceed with the activity.

Activity:
Send "Gofers" from each group to collect one container of mixed food items, one set of food cards, one grub cup, enough goggles for each member to have a pair, and a set of appendages. Caution the class against eating any of the "food" to be used.

Working in cooperative learning groups of four, have students select one beak appendage from the set and draw for a food type from the food cup. Then ask each student to predict and record in his/her investigative journal how well the selected appendage grabs the assigned grub type. Remind each student to explain in the journal the ideas on which he/she based his/her hypothesis. Have each grabber collect grub for 60 seconds and place it in his/her grub cup. Ask, "Why must we repeat this process twice more?" The question evaluates whether students know that results should be repeatable and that scientific validity comes from multiple trials. Ask students to draw into their journals a data table like the one on the student sheet and fill in the data as collected. Circulate among the groups asking and answering questions and make sure students are following directions. Have each student pour the grub collected on a piece of paper and count the number of items collected; make adjustments for "wrong" grub as decided by the teacher. Make sure students record all group findings and observations in their personal journals. All grub should be returned to the feeding container only after counting and recording all grub from the three trials. As soon as all groups have finished the first three trials, ask them to discuss possible reasons for the decreasing number of grub pieces available to be grabbed as they moved from trial one to trial three. Ask the "Reporter" from each group to report their consensus explanations. Help them understand that changing "probability" (chance) is playing a role here in the grab for grub.

Now direct the students to pass their appendages to the left. Using their new appendage, they grab the same type grub as before for three trials, always returning the grub to the feeding container before shifting appendages again. Students should record all data in their journal charts. After all trials have been completed (all four appendages used) and data recorded, have the "Reporters" record the charts from journals of all team members on boards around the room, clustering charts by food items. Now lead a discussion of reasons the sums vary from group to group and which "appendage-food type" combination seems to be the most efficient. Develop one "Composite Chart" on the board that combines all group data showing relationships supported by most trials done in the class as a whole.

Post-Activity:

Have each group create a bar graph from the combined data showing the success of each appendage using the different food sources. Check each group's graph and ask students within the groups to explain their findings. Describe several different environments asking the groups to decide which birds with a specific appendage would best survive. As a homework assignment, ask students to research examples of other ways some species have adapted for survival.

Student Questions and Answers:

1. How did you evaluate your success at gathering your grub? *The number of correct items grabbed in the total time period minus any penalty for wrong grub grabbed measures success. The more appropriate grub grabbed while grabbing the least inappropriate would be the best results.*
2. How did the chosen appendage affect your gathering ability? *The appendage determined the shape, size, and kinds (texture) of grub that could be grabbed effectively.*
3. Which appendage was the best at gathering your identified food source? Explain the answer. *Answers will vary. Students should justify their answers citing grub shape, size, and kinds (texture) considerations as well as the effectiveness of the shape of the "beak" in grabbing the grub.*

4. Why do different sizes and shapes of beaks exist within the same species? *Different sizes and shapes of beaks exist within the same species because of adaptations to minor environmental differences through natural selection and genetic variation over time. As environmental conditions change long term in one location for whatever reason, those organisms that have genetic differences giving them an advantage among their peers will survive and multiply. Those that cannot adapt to the changes may dwindle in numbers and eventually disappear. However, in a different environment, the original organisms may dominate the competition. Hence it is possible for different sizes and shapes of beaks to exist within a species.*
5. Explain why diversity within a species is important and how heritable traits ensure survival. *The more diverse the population of a species, the better chance of survival in diverse environments or during long-range localized environmental change.*
6. Predict the outcome if all group members use the same appendage and gather the same food source. *The food supply will diminish rapidly resulting in reduced availability of food to the organisms. Starvation and a reduction in population numbers would follow.*

Additional Questions:

1. What are some other adaptations animals have developed within a species? Name at least two.
2. What could adaptation eventually lead to over a long period of time?
3. Predict what would happen if a plant disease destroyed all of one's food source?
4. Why are adaptations important?

Extensions:

1. Present the class with several scenarios concerning 1) the effects on a population with a certain type of appendage if the food type changes quickly, 2) the effects on food type and population if the number of birds with the most efficient "appendage" suddenly increases dramatically (overpopulation), and 3) how "survival of the fittest" applies when either 1 or 2 happens. Through questioning of groups, determine whether students understand the relationship between form and function of appendages and the relationship between food-type availability and population dynamics. Use the scenario of mainland birds (including mutants) blown by a storm to an island having a much different environment and the ability of the birds to adapt and survive in the new environment to evaluate understanding and critical thinking/process skills.
2. Discuss natural selection and ways that certain traits have been favored in various environments. Some mutations have led to adaptations that have ensured survival. Example: bacteria that have developed resistance to antibiotics.
3. Discuss two predators that eat the same prey and the competition between species.

Reading Comprehension Connection: I-3, II-2 and 3, IV-4 (See page B-11.)

Resources:

Books:

Bendick, Jeanne. *Adaptations.* Franklin Watts, 1971.

Cook, Beverly Courtney. *Invite a Bird to Dinner: Simple Bird Feeders You Can Make.* Lothrop, Lee and Shepard, 1978.

Internet:

University of Michigan-Museum of Zoology- Bird Beaks
http://www.ummz.lsa.umich.edu/birds/Anatomy/body/beaks.html
Chicago Academy of Sciences: Chicago Science Explorers Program
http://www.caosclub.org/nsw/web/cse/csehome.html
Orange County Florida Public Schools - Science Curriculum
http://www.ocps.k12.fl.us/framework/sc/
Minnesota Valley National Wildlife Refuge - Birds, Beaks, and Adaptations
http://www.fws.gov/r3pao/mn_vall/env_educ/element/mnvlbb.html

A Grab For Grub
(Student Handout)

Purpose: To identify the appendage most effective at grabbing grub

Background:
Imagine a flock of birds, all of the same species, that are suddenly swept by a storm from their continental habitat to a very different island hundreds of miles away. The foods on this island are very different from those of their homeland. Many of the birds gradually starve to death, but a few survive. Many years later the island is populated by relatives of the original birds that look different from most of those that were carried there by the storm. What might account for the change(s) observed?

Materials:

Container of mixed food items (one per group)	Set of assorted appendages
1 grub cup for each group member	Goggles
1 set of "food cards" in Director's cup	

Safety Considerations: Always follow lab safety procedures. Food items should not be eaten.

Procedure:
1. Choose an appendage from the set provided by the teacher.
2. Draw for the food item.
3. Predict/Hypothesize which appendage/food source combinations will grab the most grub.
4. Grab for your particular grub for 60 seconds as the teacher directs. Place the grub in the grub cup. Grabbing grub other than yours will lower the score.
5. Pour out the grub from the grub cup and count the number of the food items gathered. Subtract the number of other food items. Record this number. Set grub aside. Do NOT pour back into the feeding container.
6. Repeat Steps 4 and 5 two additional times using the same appendage gathering the same food item.
7. Sum the results from the three trials recording this sum in the data table.
8. Return all food items to the feeding container.
9. Exchange appendages with the group member to your left.
10. Keeping the original food item, repeat Steps 4-9 until you have used each appendage to gather grub three times.
11. Based on the experiences and observations, what revision, if any, do you want to make in your hypothesis?

Data Table:

Food Source→				
Appendage	**Trial #1**	**Trial #2**	**Trial #3**	**Sum**

Questions:

1. How did you evaluate your success at gathering the grub?
2. How did the chosen appendage affect your gathering ability?
3. Which appendage was the best at gathering your identified food source? Explain your answer.
4. Why do different sizes and shapes of beaks exist within the same species?
5. Explain why diversity within a species is important and how heritable traits ensure survival.
6. Predict the outcome if all group members use the same appendage and gather the same food source.

Dork DNA
(Teacher Notes)

Standard-Objective-Eligible Content: IV-1, c; IV-2, a and b (See pages B-2 - B-10.)

Lab Time: 50-60 minutes

Background:
Genes on chromosomes are sections of DNA that determine the structure of polypeptides (building blocks of proteins) that cells make. The code in the sequence of nucleotides of DNA determines the sequence of amino acids in those polypeptides. However, three types of RNA must carry out those DNA instructions since DNA does not leave the nucleus.

Materials: See student handout.

Pre-Activity: (15 minutes)
Prepare flash cards (construction paper or index cards) in advance for modeling protein synthesis:

3 Red (amino acids) , Glutamic acid, Alanine
6 Blue (DNA)- GGC, CTT, CGT/ CCG, GAA, GCA (complementary)
3 Yellow (mRNA)-CCG, GAA, GCA
3 Orange (tRNA)- GGC, CUU, CGU
1 Green (enzyme)

Add more cards to each category to provide detractors.
This activity should follow and reinforce student discussion of protein synthesis and the role of transcription and translation. To model these processes, a pre-lab activity could include using the prepared flash cards to allow students to role play as a DNA triplet, an mRNA codon, a tRNA anticodon, or matching amino acid.

Table 1

Amino Acid	DNA triplet
Alanine	CGT
Glutamine	GTT
Glutamic Acid	CTT
Leucine	GAT
Lysine	TTT
PhenylAlanine	AAA
	GGC
Serine	AGC
Tyrosine	ATG
Valine	CAA

1. Display Table 1 as a transparency or poster or on the board. Identify the amino acids that make up a protein, such as Proline, Glutamic acid, and Alanine, and the area of the room that will represent the "nucleus." Call on the students with blue DNA triplets to form a double-stranded DNA molecule to represent the proper code for those amino acids. Hands placed on the shoulders across can represent bonds between complementary strands.

2. The student with the green enzyme card "unzips" the DNA strands to allow the students with yellow mRNA codons to step in and pair up with the complementary DNA strand.
3. Those mRNA codons join hands and move out of the nucleus as the DNA strands rejoin.
4. Designate the area of the room that represents the ribosome where mRNA codons line up.
5. Students with orange tRNA anticodon flash cards should then bring matching students with red amino acid flash cards to the ribosome area.
6. As proper pairing of mRNA codon and tRNA anticodon occurs (hands on shoulders), peptide bonds (joined hands) should form between amino acids.
7. When this simple protein has formed, the mRNA, tRNA, and polypeptide chain leave the ribosome. If further practice is necessary, try these amino acid sequences (short protein): lysine, glutamine, valine : leucine, , tyrosine. Be sure to prepare additional flash cards for the synthesis of each particular protein.

Activity: (45 minutes)

1. Instruct student groups to follow the procedures of "Dork DNA" to practice the relationships among DNA, genes, and chromosomes.
2. As groups complete Data Tables, check for accuracy and reinforce the idea that the Part B Dork can only inherit one form of each trait (i.e., cannot have both blue skin and green skin).
3. Question groups concerning their understanding of the sequence of events in protein synthesis.

Post-Activity: (15 minutes)
Use discussion format to allow each group to respond to the questions posed in the student observation section.

Sample Data:

Part A

Data Table 1:

Gene A	Gene B	Gene C
DNA - ACC GGT TAT	DNA – AGC CGA	DNA – TTT AAC
MRNA – UGG CCA AUA	MRNA – UCG GCU	MRNA – AAA UUG
TRNA – ACC GGU UAU	TRNA – AGC CGA	TRNA – UUU AAC
Amino Acid Sequence – 20-12-13	Amino Acid Sequence – 16-2	Amino Acid Sequence – 9-4
Trait – hairy	Trait – four-legged	Trait – spots
Gene D	**Gene E**	**Gene F**
DNA – GGA CGC CGA	DNA – GGG AGG AAA CCC	DNA – ATC ATC CTA
MRNA – CCU GCG GCU	MRNA – CCC UCC UUU GGG	MRNA – UAG UAG GAU
TRNA – GGA CGC CGA	TRNA – GGG AGG AAA CCC	TRNA – AUC AUC CUA
Amino Acid Sequence – 11-3-2	Amino Acid Sequence – 5-7-8-1	Amino Acid Sequence – 6-6-10
Trait – blue skin	Trait – short nose	Trait - male

Part B (will vary with student-created lists)

Student Questions and Answers:

1. Explain the roles of transcription and translation. *Transcription is the process where information in one strand of DNA specifies a complementary sequence of bases in mRNA. Translation is the process by which a strand of mRNA directs the sequence of amino acids during protein synthesis.*
2. What would happen to the protein for Dork skin color if the last DNA triplet was CGC instead of CGA? *The skin color would change to green due to this point mutation.*
3. Is it likely that a change in a single nucleotide in DNA could cause the protein that results in plump Dorks to be mutated into the one for skinny Dorks? Why? *No, the amino acid sequences for those traits are not closely related and unlikely to be affected by such a point mutation.*

Additional Questions:

Suppose you knew the specific proteins in a cell. How would you determine the particular DNA code that formed them?

Extensions:

This lab lends itself well to extensions such as genetic diseases or genetic engineering.

Reading Comprehension Connection: I-2, II-3, IV-3 (See page B-11.)

References:

Books:

Miller, Kenneth R. and Joseph Levine. *Biology.* Prentice Hall, 1993. pp. 136-153, pp. 212-214. pp. 180-192.

Schraer, William D. and Herbert J. Stoltze. *Biology The Study of Life* . Prentice Hall, 1993.

Towle, Albert. *Modern Biology.* Holt, Rinehart and Winston, 1993. pp. 112-123, pp. 163-177.

Dork DNA
(Student Handout)

Purpose: To show how traits on a chromosome determine the characteristics of an organism

Background:

Genes are the units on chromosomes that determine inherited traits or characteristics. Actually, genes are segments or lengths of DNA molecules that carry the information in code form for building a protein. Together, DNA and its assistant RNA are responsible for making the proteins that build cell structures, cause cell movement, and act as enzymes in the chemical reactions that support the cell's life. In this activity, you will simulate the assembly of protein molecules (made up of amino acids) to determine the traits inherited by a fictitious organism called a Dork. Dork cells have only one chromosome made up of six genes. Each gene is responsible for a particular trait (protein).

Materials:

Blue pencils	Construction paper
Green pencils	Index cards

Safety Considerations: Always follow lab safety procedures.

Procedure: Part A

1. The first step in determining the trait for Gene A is to notice the sequence of DNA nucleotides given in Data Table 1. On the line provided, list the sequence of nucleotides of mRNA that would be complementary to that DNA. **A** always corresponds to **T** (**U** in RNA), and **G** always corresponds to **C**. This process called transcription would take place in the nucleus.
2. The mRNA carries this information as triplet codons to the ribosomes in the cell's cytoplasm. However, another type of RNA called transfer (tRNA) is needed to bring mRNA and amino acids together to build that specific protein. On the line provided for Gene A, write the sequence of tRNA anticodons that are complementary to the mRNA.
3. To determine the sequence of amino acids, match each tRNA triplet with the particular amino acid in Chart 1. Separate each amino acid number with a hyphen as you record it on the next line of Data Table 1.
4. Using Chart 2, match the amino acid sequence to the trait this protein controls. The process by which the information from DNA has been transferred into the language of proteins is known as translation.
5. Repeat Steps 1 through 4 to find the traits for Genes B through F.
6. Using all the inherited traits, sketch your Dork.

Chart 1		Chart 2	
TRNA triplet	**Amino Acid Number**	**Amino Acid Sequence**	**Trait**
ACC	20	20-11-13	Hairless
AGC	16	20-12-13	Hairy
CGA	2	20-21-21	Plump
AAC	4	13-14-15	Skinny
CGC	3	16-2	Four-legged
GGG	5	16-5	Three-legged
AGG	7	12-7-8-1	Long nose
AAA	8	5-7-8-1	Short nose
UUU	9	9-8	No spots
GGU	12	9-4	Spots
UAU	13	11-3-2	Blue skin
CCC	1	11-3-3	Green skin
AUC	6	6-6-10	Male
CUA	10	6-6-14	Female
GGA	11		

Data Table 1:

Gene A	Gene B	Gene C
DNA - ACC GGT TAT	DNA – AGC CGA	DNA – TTT AAC
MRNA -	MRNA -	MRNA -
TRNA -	TRNA -	TRNA -
Amino Acid Sequence -	Amino Acid Sequence -	Amino Acid Sequence -
Trait -	Trait -	Trait -
Gene D	**Gene E**	**Gene F**
DNA – GGA CGC CGA	DNA – GGG AGG AAA CCC	DNA – ATC ATC CTA
MRNA -	MRNA -	MRNA -
TRNA -	TRNA -	TRNA -
Amino Acid Sequence -	Amino Acid Sequence -	Amino Acid Sequence -
Trait -	Trait -	Trait -

Sketch your Dork here:

Procedure: Part B

1. Now your group will challenge another group to determine original DNA code from a Dork's traits that you have selected. On an index card, simply list the six traits (Genes A-F) you have chosen for this new Dork. Exchange that list with someone in another group.
2. As you receive a new list of traits, fill in Data Table 2 by finding the amino acid sequence, the tRNA triplets, mRNA codons, and finally the original DNA for each trait.
3. Sketch the new Dork you inherited.

Data Table 2:

Gene A	**Gene B**	**Gene C**
Trait -	Trait -	Trait -
Amino Acid Sequence -	Amino Acid Sequence -	Amino Acid Sequence -
TRNA -	TRNA -	TRNA -
MRNA -	MRNA -	MRNA -
DNA –	DNA –	DNA –
Gene D	**Gene E**	**Gene F**
Trait -	Trait -	Trait -
Amino Acid Sequence -	Amino Acid Sequence -	Amino Acid Sequence -
TRNA -	TRNA -	TRNA -
MRNA -	MRNA -	MRNA -
DNA –	DNA –	DNA –

Sketch your Dork here:

Questions:

1. Explain the roles of transcription and translation.
2. What would happen to the protein for Dork skin color if the last DNA triplet was CGC instead of CGA?
3. Is it likely that a change in a single nucleotide in DNA could cause the protein that results in plump Dorks to be mutated into the one for skinny Dorks? Why?

Irregular Jeans
(Teacher Notes)

Standard-Objective-Eligible Content: IV-1, a and b; IV-2, d ; I-1, a (See pages B-2 - B-10.)

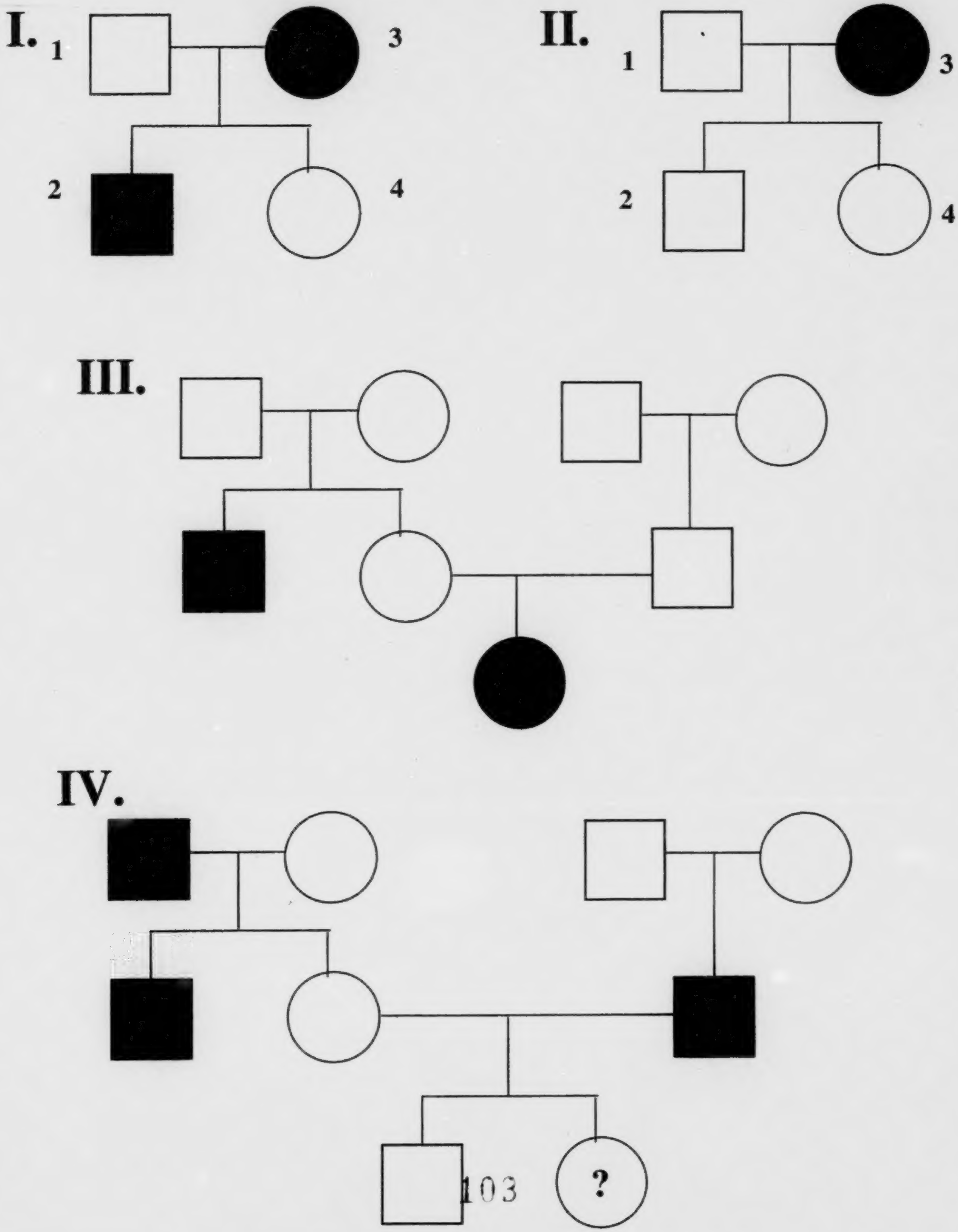
Lab Time: 60-90 minutes

Background:
Make sure students have an understanding of Mendelian genetics, pedigree analysis, and biochemical pathways. Discuss the cause of Alcaptonuria and its symptoms. Alcaptonuria is caused by a defect in the enzyme homogentisic acid oxidase. This enzyme converts homogentisic acid into the next substrate. If defective, this enzyme carries out this conversion slowly and inefficiently, leading to high concentrations of homogentisic acid in body fluids. Archibald Garrod, a turn-of-the-century English physician interested in heredity, first described Alcaptonuria. Most of the clinical features of Alcaptonuria are due to the fact that homogentisic acid turns black when oxidized. Diapers of the Alcaptonuric tend to stain black as the homogentisic acid in the urine oxidizes. A high pH increases oxidation so that washing diapers in alkaline soap makes the stains even darker. Later in life, deposits of oxidized products of homogentisic acid may cause connective tissues to become gray or black. Sometimes dark spots may even form on the cartilage of the ear or on the sclera of the eye. Arthritic conditions and degeneration of the spinal disks may also occur later in life. None of these symptoms are life-threatening, and alcaptonurics appear to have normal life spans. Alcaptonuria is rare worldwide with probably the highest incidence of this disease occurring in Northern Ireland. Here, three to five people per million are Alcaptonurics. It is also more common in parts of the world where inter-family marriages and inbreeding occurs.

Materials: See student handout.
Artificial "urine" is prepared by adding yellow food coloring to water.
Spiked "urine" is prepared by adding starch solution to the artificial "urine."
Iodine serves as the Alcaptonuria test solution

Pre-Activity: (12-20 minutes)

Figure 2: Inheritance of the Genetic Condition Alcaptonuria


I.
1
3
2
4
II.
1
3
2
4
III.
IV.
?

The accompanying diagrams are illustrations of pedigrees of four different families (Figure 2). Darkened symbols represent individuals who, using the urine test, have been shown to have Alcaptonuria. Make copies of these diagrams for the students as well as a transparency that can be used to review pedigrees. In Example I, Individual 1 must be (**Aa**) in order for his son, Individual 2, to have the disease (**aa**). The daughter, Individual 4, must also be (**Aa**) meaning that she inherited the (**A**) allele from her father and the (**a**) allele from her mother. In Example II, only the daughter, Individual 4, has the disease. This means that she must have inherited the (**a**) allele from both of her parents even though neither of them has the disease. This means they both must be carriers (**Aa**). In the family of 8 in Example III, it is possible to determine the genotype of every individual except the two paternal grandparents by reasoning back from the two (**aa**) individuals. Even then, both of the paternal grandparents must be (**Aa**), or one is (AA) and the other is (**Aa**). In Example IV, the situation is different. We do not know the genotype of the daughter "?" in the third generation. She is out of the country, which means that a urine sample is not available for her. Working backward from the three (**aa**) individuals, it is possible to arrive at the genotypes of all the other family members. In the role of genetic counselors, students can assert that the likelihood of the daughter "?" having Alcaptonuria (**aa**) is 50% and being a carrier (**Aa**) is 50%.

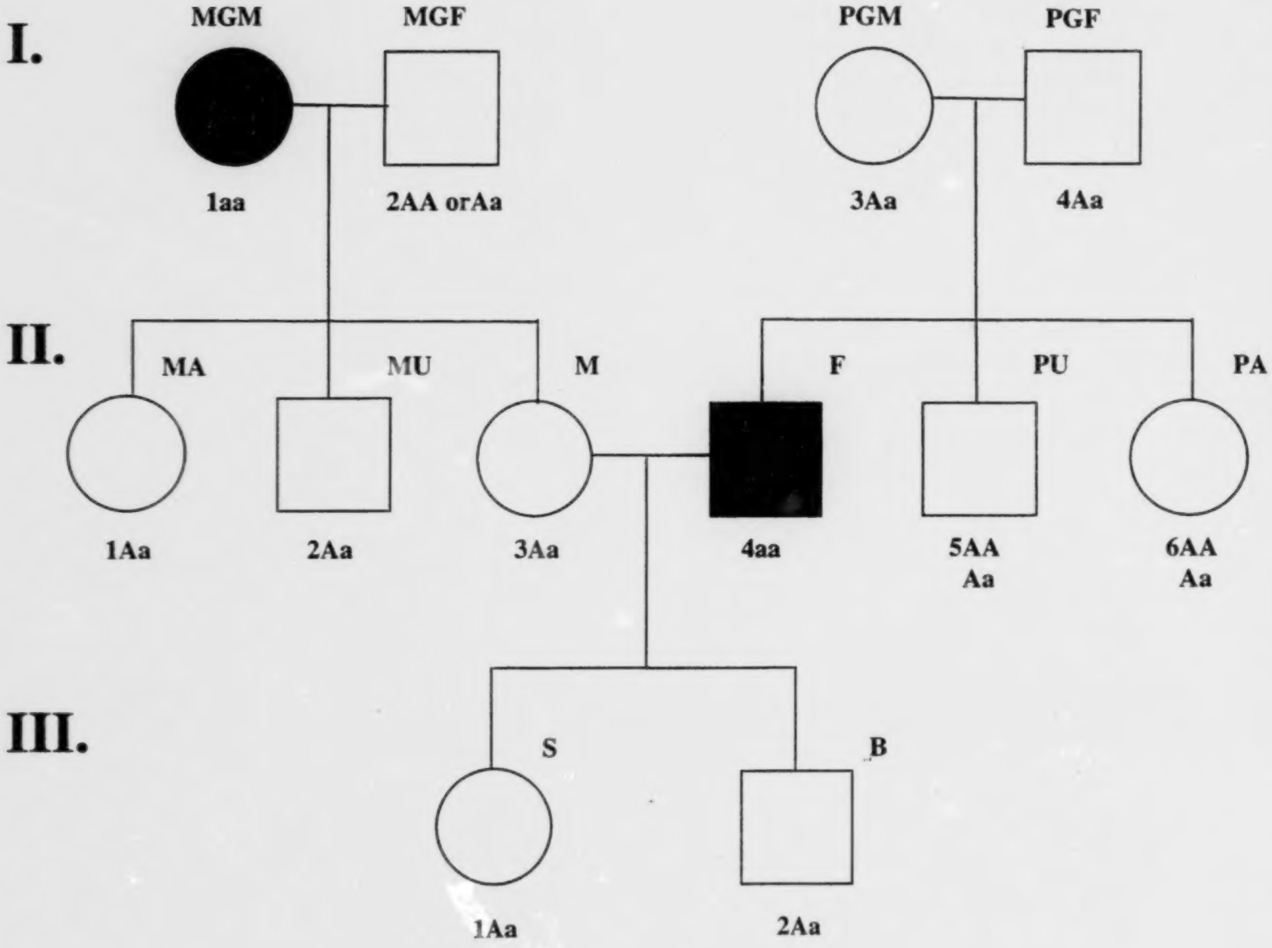
1. Prepare the artificial "urine" in the following way: Drop several drops of yellow food coloring into water until desired color is reached. Or simulated urine from biological supply companies can be purchased if preferred.
2. Label 12 test tubes per group with the following information: PGF, PGM, MGF, MGM, F, M, PA, PU, MA, MU, B, and S.
3. Pour artificial "urine" into all test tubes.
4. Choose the following family members that you want to test positive for Alcaptonuria: MGM and F. Spike the urine in those test tubes in this way: Dissolve starch in water by heating it until it dissolves clear. Add the starch water to the MSG and F test tubes. Be sure to fill all test tubes to the same level.
5. Prepare several bottles of Alcaptonuria test solution (iodine). These can be shared among the groups.

Activity: (30 minutes)
Circulate among groups as they follow the student-procedure steps. Ask questions to determine their understanding of the pedigree labeling and the urine testing.

Post-Activity: (10-15 minutes)
Discuss any differences in group pedigrees and answers to questions on student handouts.

Answers to Questions:

Figure 1
Family pedigree—Study of Alcaptonuria


I.
MGM
MGF
PGM
PGF
1aa
2AA orAa
3Aa
4Aa
II.
MA
MU
M
F
PU
PA
1Aa
2Aa
3Aa
4aa
5AA
Aa
6AA
Aa
III.
S
B
1Aa
2Aa

Student Questions and Answers:

1. Could a genetic disease "suddenly" show up in a family? Explain the answer. *Yes. A recessive gene could be "carried" for many generations and never be expressed until another carrier marries a recessive carrier in the family.*
2. What is another genetic disease that you know? *Albinism, Huntington disease, cystic fibrosis, sickle cell anemia, muscular dystrophy, hemophilia.*
3. Why are most recessive trait diseases not common in human populations? *Because they are recessive, it takes two recessive traits (alleles) getting together for the disease to show up. Both parents must be carriers, and then there is only a 25% chance of the disease showing up in an offspring.*
4. Why would marriages between family members increase the likelihood of genetic diseases showing up? *If a genetic disease runs in a family, then the chances of two carriers marrying each other are much greater when members of that family intermarry. This is the reason hemophilia was so prevalent in royal European families.*

Extensions:

Students in groups may research a particular genetic disease and report back to the class. Reports should include history, symptoms, defects, dominant or recessive inheritance, and frequency among births. In particular, the continued occurrence of sickle cell anemia in Africa and Asia is of interest since the heterozygous condition (carrier) confers partial immunity to malaria.

Reading Comprehension Connection: I-3, II-2, II-3, IV-4 (See page B-11.)

Resources:

Books:

Johnson, George B. and Peter H. Raven. *Biology Principles & Explorations.* Holt, Rinehart and Winston, 1996. pp. 154-159.

Irregular Jeans?

(Student Handout)

Purpose: To recognize how genetic diseases are passed from one generation to the next

Background:

Genes are passed from one generation to the next. The inheritance of the disease being studied in this activity can be explained by using the principles that were first discovered by Gregor Mendel in his garden pea experiments. Laws of probability and pedigree analysis will be used to study the inheritance of a recessive gene that leads to a disease called Alcaptonuria. This activity will trace the inheritance of Alcaptonuria through two to three generations of a family. By using information provided, you will be able to determine the genotypes of past and present family members as well as be able to predict the possible inheritance of this disease in the next generation. Alcaptonuria is classified only as a mild genetic disease because it does not cause fetal damage, physical defects, or mental retardation. Normally, amino acids, such as phenylalanine and tyrosine, are broken down into the waste products, water and carbon dioxide, that can be seen in the following pathway:

Tyrosine - P-hydroxyphenylpyruvic Acid - Homogentisic Acid - Maleylacetoacetic Acid - Additional Steps - Water and Carbon Dioxide

The enzyme homogentisic acid oxidase helps break down homogentisic acid into the next substrate maleylacetoacetic acid. In a normally functioning pathway, homogentisic acid is almost undetectable in body fluids. But in a person with Alcaptonuria, this enzyme is defective. The defective enzyme carries out the conversion slowly and inefficiently leading to high concentrations of homogentisic acid in body fluids such as urine and blood serum. Currently, the gene location for this mutated gene is unknown; however, it is believed to be located on one of the 22 autosomes (non-sex chromosomes) since it appears both in males and females with about equal frequency. The normal allele is dominant (**A**), and the Alcaptonuria allele is recessive (**a**). Only individuals who inherit the recessive gene from both parents and are homozygous recessive (**aa**) have Alcaptonuria. Individuals who are homozygous dominant (**AA**) or heterozygous dominant (**Aa**) are both normal and do not have Alcaptonuria.

Materials: (per group)

Test tube rack
Safety goggles
12 test tubes
Artificial "urine"
Spiked "urine"
Alcaptonuria test solution

Safety Considerations:

Safety goggles must be worn at all times during this lab. The Alcaptonuria test solution is poisonous and will stain clothing, skin, and paper products. Be careful not to spill it.

Procedure:

1. Obtain the test tube rack containing the labeled urine samples of family members.
2. Label the pedigree symbols (Figure 1) with the following information that corresponds to the labels on the urine samples (Females are circles, and males are rectangles).
   - PGF - paternal grandfather
   - PGM - paternal grandmother
   - F - father
   - PA - paternal aunt
   - PU - paternal uncle
   - B - brother
   - MGF - maternal grandfather
   - MGM - maternal grandmother
   - M - mother
   - MA - maternal aunt
   - MU - maternal uncle
   - S - sister
3. Test the urine of each person by placing two drops of the Alcaptonuria test solution into each sample.
4. Carefully agitate the test tubes and look for positive tests (formation of dark color).
5. Determine which family members have the disease and mark them on the pedigree (Figure 1) by coloring in their symbol.
6. Using the genetic information about this disease, write in the genotype on the two lines below each person's symbol on the pedigree (Figure 1).
7. Describe the phenotype for each person in the space provided below the pedigree (normal or Alcaptonuria).
8. Return the Alcaptonuria test solution to the teacher.
9. Dispose of the urine according to the teacher's instructions.
10. Clean all glassware.

(adapted from Alabama Science in Motion lab)

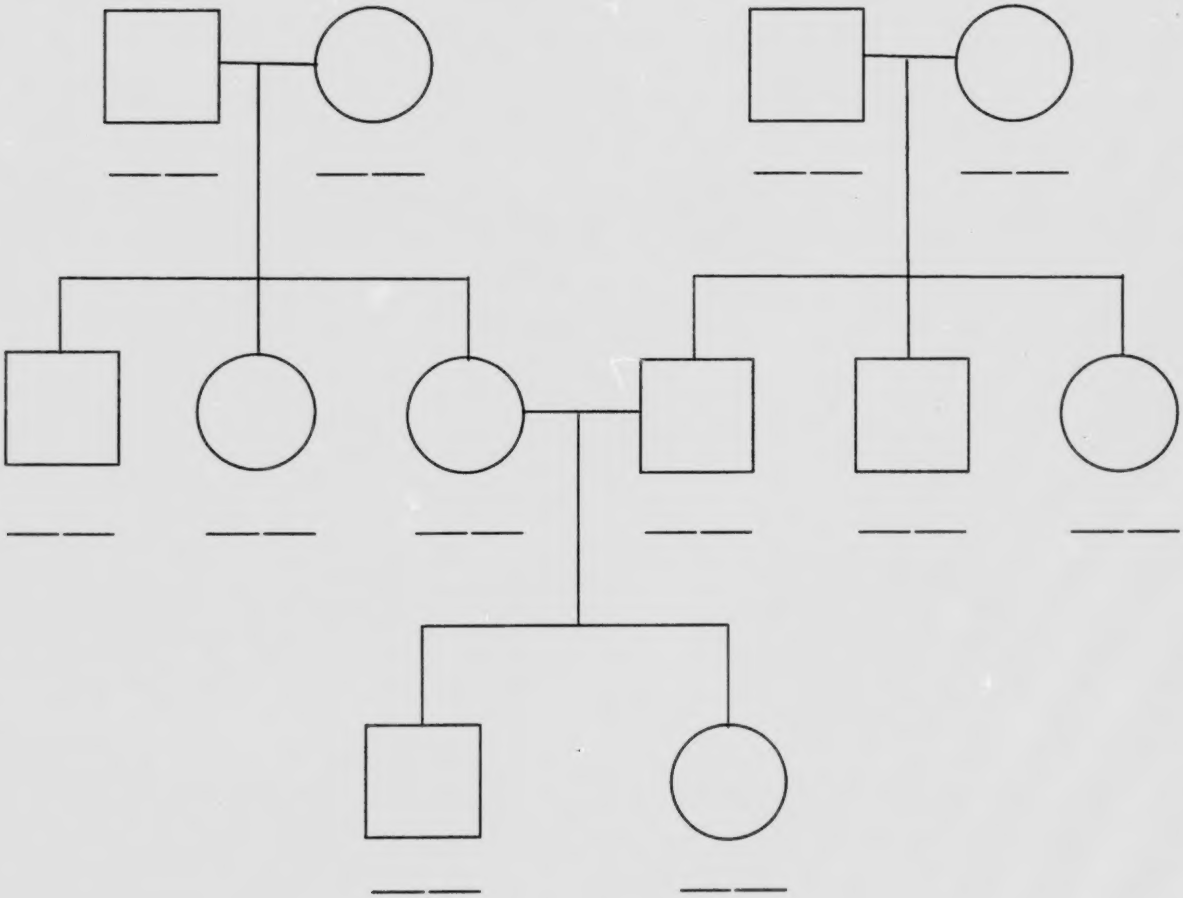
Name:______________________________

Name:______________________________

Name:______________________________

Pedigree:

Figure 1
Family Pedigree-Study of Alcaptonuria



Describe the phenotype of each individual.

PGF ______________________
PGM ______________________
MGF ______________________
MGM ______________________
F ______________________
M ______________________
PA ______________________
PU ______________________
MA ______________________
MU ______________________
B ______________________
S ______________________

Questions:

1. Could a genetic disease "suddenly" show up in a family? Explain your answer.
2. What is another genetic disease that you know?
3. Why are most recessive trait diseases not common in human populations?
4. Why would marriages between family members increase the likelihood of genetic diseases showing up?

It's A Toss Up
(Teacher Notes)

Standard-Objective-Eligible Content: IV-1-a and d, 2-d (See pages B-2 - B-10.)

Lab Time: 1-day activity/1- day post-activity/extension

Background:

Heredity is the passing of traits from parent to offspring. The units of heredity are genes found on chromosomes. The combination of genes for each trait occurs by chance. When one gene in a pair is stronger than the other, it is the dominant gene and is designated with a capital letter. The masked or hidden gene is recessive and is written as lowercase. If both genes in a gene pair are the same, the trait is said to be pure or homozygous. If the genes are not similar, the trait is said to be hybrid or heterozygous. Sometimes genes are neither dominant nor recessive and result in a blending of traits.

The genetic makeup of the individual is known as its genotype and is designated with letters that represent the gene pair. The observable physical trait of the individual that results from this genotype is known as its phenotype.

In humans the sex of the individual is determined by the combination of two sex chromosomes, one from the male parent and one from the female parent. Individuals can inherit only an X chromosome from the female parent. If that X is combined with an X from the male parent, the offspring will be female (XX). If the X is combined with a Y from the male parent, the offspring will be male (XY). Thus the male parent determines the sex of the offspring.

Materials:

2 coins or disks marked "H" on one side and "T" on the other
Facial Features Charts (one for every 3 students)

Pre-Activity: (15 minutes)

Since this activity reinforces basic genetic principles, it is important to have firmly established student understanding of monohybrid (single trait) crosses. A pre-lab review/quiz of inheritance laws might include assessing student mastery of these prerequisite skills and concepts. The use of the group discussion and responses in the background of the student sheet is such an approach.

Activity: (30-40 minutes)

1. Give each group a Facial Features Chart and two coins (or small disks with H on one side and T on the other) to follow the procedures.
2. As the tossing begins, reinforce the idea of each parent contributing one half (an allele) for each trait (gene).
3. Instruct groups to answer questions following third offspring. Circulate among the groups to check their progress. Ask further guiding questions when necessary.

Post-Activity:

Some human genetic disorders are caused by a change in either a single recessive gene or a single dominant gene. Have student groups accept responsibility for researching some of the most common of these to report to the class including such information as cause, symptoms, possible benefit or harm, segment of the population affected, possible treatment, prognosis.

Sample Data and Calculations:

Sex of the offspring = XX (Female)

Chart (GT= genotype)

SKETCH OF OFFSPRING

TRAIT	GT	PHENOTYPE
Face shape	Rr	round
Chin cleft	cc	absent
Widow's peak	ww	absent
Hair	Hh	wavy
Eye size	Ll	medium
Eye shape	aa	round
Eye position	SS	straight
Eye space	Ee	normal distance
Eyebrow position	Nn	not connected
Eyebrow shape	Bb	fine
Eyelash length	LL	long
Mouth size	Ll	medium
Lip shape	Tt	normal
Dimples	Dd	absent
Nose size	Ll	small
Ear size	Ll	normal
Freckles	FF	present

Student Questions and Answers:

1. Why was it appropriate for the male parent to flip for the sex of the offspring? *Males contribute the sex-determining X or Y chromosome. If the male contributes X, the child will be female. If the male contributes Y, the child will be male.*
2. What percent chance was there for producing a male offspring? A female? Explain. *There is a 50% chance of either since there is also a 50% chance of heads or tails. There are only two possible outcomes to flipping the coin and only two possible types of genes that determine gender.*
3. What do the coins represent? *The coins with heads and tails represent the possible genes (alleles) of that trait that each parent could contribute.*
4. What determined the observable physical characteristics of the offspring? *The combinations of tosses represent the chance results of genes (genotype) contributed by each parent.*
5. Were all three offspring in your group alike? Would you expect other groups to have offspring very similar to yours? Explain. *Not likely. Not likely. Chance plays such an important role, and there are many combinations of genes.*
6. What are the possible genotypes for the parents of a child who has wavy hair? *HH x Hh, or Hh x Hh, or Hh x hh*
7. Which traits in this activity do not show simple dominance but a blending of traits? *Mouth size, nose size, ear size, lip shape, hair type, eye spacing*

8. How would it be possible for the offspring to show a trait that physically neither of the parents shows? *If both parents are heterozygous genotype for the trait, they can each pass on the hidden recessive. The recessive phenotype is only seen if it is homozygous.*

Extensions:
This would be a good opportunity to practice genetic probability problems. Example: If a woman who was homozygous for curly hair (HH) married a man who was heterozygous, wavy-haired (Hh), what would be the possible genotype and phenotype ratios for their children?

Reading Comprehension Connection: I-3; II-2 and 3; IV-1, 4 (See page B-11.)

Resources:

Books:

Miller, Kenneth R. and Joseph Levine. *Biology.* Prentice Hall, 1993. pp. 180-192.
Scharer, William D. and Herbert J. Stoltze. *Biology – The Study of Life.* Prentice Hall, 1993. pp. 497-507.

Internet:

University of Kansas Medical Center - genetics directory
http://www2.kumc.edu/instruction/sah/med_tech/mt705/mendelian/

Software:

Investigating Heredity. Cyber Ed Inc. Order # 0991128HY.
Mendel's Principles of Heredity. Cyber Ed Inc. Order # 0991102HY.

Videos:

Hand-Me-Down Genes – An Introductions to Genetics. Films for the Humanities and Sciences. Order # BTW 8449.
The Gene. Hawkhill Video. Order #110.

It's A Toss Up

(Student Handout)

Purpose: To explore how traits are passed from parent to offspring

Background:
Heredity is the passing of traits or characteristics from parent to offspring. The units of heredity are the genes that are found on chromosomes in the cells. In this activity, you will observe the results of how different gene combinations produce certain traits. Before starting, discuss these ideas with the group and write the answers in your own words:

1. What do the terms **dominant** and **recessive** mean?
2. Explain the difference between the **genotype** and the **phenotype** of an individual.
3. How are dominant and recessive genes written or abbreviated in a **genotype**?
4. How can you tell by looking at the genotype of the individual if he/she is **homozygous** or **heterozygous** for that trait?

Materials/Equipment:
2 coins
Facial Features Chart
Pencil

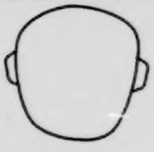
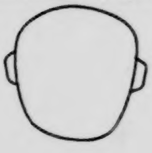
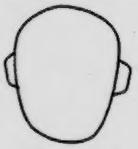
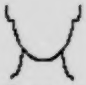
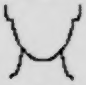
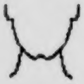
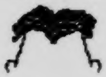
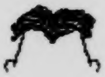
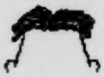
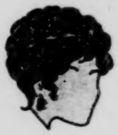
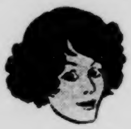
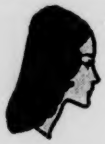
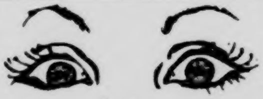
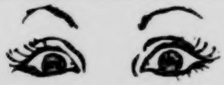
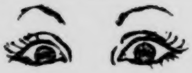
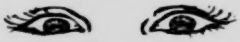
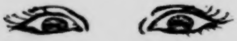
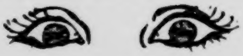
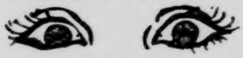
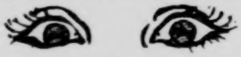
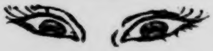
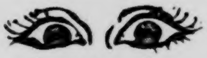
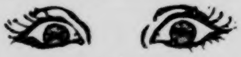
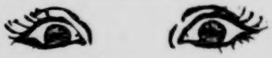
Safety Considerations: Always follow lab safety procedures.

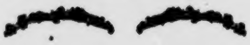
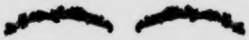
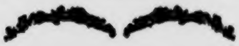
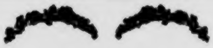
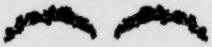
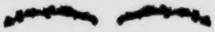
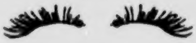
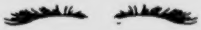
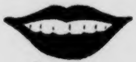
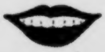
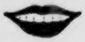
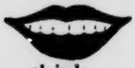
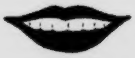
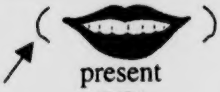
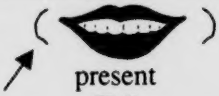
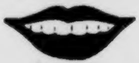
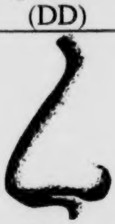
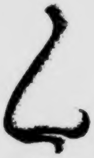
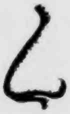
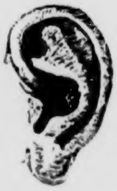
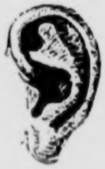
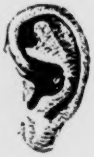
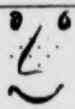
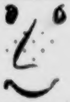
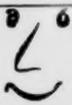
Procedure:
1. Work in teams of three. Assign one group member to toss for the female parent, one for the male, and one to be the offspring. The offspring will record the traits that result from the tosses and sketch the facial features that he or she has inherited from the parents on the observation sheet.
2. Have the team member who is representing the male parent flip a coin to determine the sex of the offspring. If the coin lands heads, the offspring is female. If it land tails, the offspring is male. Record the sex of offspring 1 in the sketch box provided.
3. From now on, heads will represent a dominant gene, and tails will represent a recessive gene. Both coins should be flipped at the same time but only once for each trait. Record the genotype and phenotype that result from the coin toss for the first trait.
4. Continue to flip both coins for each facial trait. Use the completed list of phenotypes to sketch the resulting offspring.
5. Next, each team member should be assigned a different role and repeat Steps 1-4 so that a different member will sketch the next offspring. Finally, switch roles a final time using Steps 1-4 to determine traits for the third offspring.

Data Table:

Sex of the offspring=_______

Facial Feature Chart

Traits	Homozygous Dominant (both heads)	Heterozygous Hybrid (one head, one tail)	Homozygous Recessive (both tails)
FACE SHAPE	 round (RR)	 round (Rr)	 square (rr)
CHIN CLEFT	 absent (CC)	 absent (Cc)	 present (cc)
WIDOW'S PEAK	 present (WW)	 present (Ww)	 absent (ww)
HAIR TYPE	 curly (HH)	 wavy (Hh)	 straight (hh)
EYE SIZE	 large (LL)	 medium (Ll)	 small (ll)
EYE SHAPE	 almond (AA)	 almond (Aa)	 round (aa)
EYE POSITION	 straight (SS)	 straight (Ss)	 slant upward (ss)
EYE SPACE	 close together (EE)	 normal distance (Ee)	 far apart (ee)

Traits	Homozygous Dominant (both heads)	Heterozygous Hybrid (one head, one tail)	Homozygous Recessive (both tails)
EYEBROW POSITION	 not connected (NN)	 not connected (Nn)	 connected (nn)
EYEBROW SHAPE	 bushy (BB)	 bushy (Bb)	 fine (bb)
EYELASH LENGTH	 long (LL)	 long (Ll)	 short (ll)
MOUTH SIZE	 large (LL)	 medium (Ll)	 small (ll)
LIP SHAPE	 thick (TT)	 normal (Tt)	 thin (tt)
DIMPLES	 present (DD)	 present (Dd)	 absent (dd)
NOSE SIZE	 large (LL)	 medium (Ll)	 small (ll)
EAR SIZE	 large (LL)	 normal (Ll)	 small (ll)
FRECKLES	 present (FF)	 present (Ff)	 absent (ff)

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Data Table:

Sex of the offspring=_______

Chart (GT= genotype)

SKETCH OF OFFSPRING

TRAIT	GT	PHENOTYPE
Face shape		
Chin cleft		
Widow's peak		
Hair		
Eye size		
Eye shape		
Eye position		
Eye space		
Eyebrow position		
Eyebrow shape		
Eyelash length		
Mouth size		
Lip shape		
Dimples		
Nose size		
Ear size		
Freckles		

Questions:

1. Why is it appropriate for the male parent to flip for the sex of the offspring?
2. What percent chance is there for producing a male offspring? A female? Explain.
3. What do the coins represent?
4. What determines the observable physical characteristics of the offspring?
5. Are all three offspring in your group alike? Would you expect other groups to have offspring very similar to yours? Explain.
6. What are the possible genotypes for the parents of a child who has wavy hair?
7. Which traits in this activity do not show simple dominance but a blending of traits?
8. How would it be possible for the offspring to show a trait that neither of the parents shows physically?

Gone Fishing
(Teacher Notes)

Standard-Objective-Eligible Content: VI-1, b, c, f; IV-1, d; I-1, a, d, e (See pages B-2 - B-10.)

Lab Time: 60-90 minutes

Background:
The environment and its components play a major role in determining the number and kinds of organisms that can be found in an ecosystem. Nonliving factors are called abiotic factors and consist of things such as soil, water, pollution, temperature, rocks. Living factors are called biotic factors and include interactions between members of the same species as well as different species. This activity will allow students to make a simplified model of an ecosystem so that they may study how some of these factors affect an eagle population.

Materials: See student handout.

Activity:
Part 1 (20 minutes)
It is best if students work in groups of two. They could use forceps to pick up the rice. Remind students to drop the "eagle" carefully and also to count the "fish" accurately if the activity is to work. If the "eagle" does not land in the "lake," have them simply drop it over again. Since this is a model and involves random sampling, different students may not get the same results and may not even get the desired results. Some students may even show the fish population to be increasing when it "should" decrease. It may be easier to go ahead and have the squares of index cards (M) and (F) ready for the students to use rather than have them make the cards.

Part 2 (30 minutes)
All groups should do factor A. Assign three additional factors to each group. Do this in a way so that all factors will be covered at least once.

Part 3 (15 minutes)
Have students check to see if the data collected supports the hypothesis they made.

Post-Activity:
Discuss biotic and abiotic factors in an environment. Using the factors in the lab, determine what was biotic and what was abiotic.

Answers To Student Questions:
Part 1
Data information will vary from group to group. But because of the size of the grid and the size of the rice grains, students should probably not collect more than five or six grains per square.

1. *Answers will vary but students should note that the fish population decreases over time because of eagle predation.*
2. *Generally the eagle population should not be affected by a small decrease in the fish population.*

Hypothesis: *Students will probably hypothesize that there will be fewer fish to go around and that one or more eagles could die as a result.*

3. *Answers will vary; but students should see that competition will make the fish population decrease more quickly, thus limiting food availability for the eagles.*

Part 2

1. *The insecticide has no effect on the fish population. It does, however, affect the eagle population by preventing the hatching of their eggs.*
2. *Yes.*
3. *An increase in the fish population does increase food availability for the eagles. This does not, however, mean that the eagle population will increase.*
4. *Seasonal changes could cause the eagles to leave their homes in search of food.*
5. *A climate change does not necessarily affect a population. The degree to which a climate change does affect a population will often be related to the severity of the change or how the change affects the needed resources for that population.*
6. *Phosphate pollution can lead to algal blooms. Algal blooms can lead to a decrease in the fish population. A decrease in the fish population limits food availability for the eagles. A decrease in food availability could lead to a decrease in the eagle population.*
7. *An increase in the eagle population will make the fish population decrease more quickly.*

Part 3: Checking the Hypothesis

Answers will vary. Students who hypothesized that there will be fewer fish and that one or more eagles might die will say their hypotheses were supported by their data.

Have each group share its findings with the class. Compare/contrast the data of groups that may have worked through the same factors. Discuss reliability at this time.

Extensions:

The students could work through all of the factors. If so, have them make additional tables.

Reading Comprehension Connection: I-2, I-3, II-2, II-3 (See page B-11.)

Resources:

Books:

Biggs, Elton, Linda Lundgren, and Chris Kapicka. *Biology: The Dynamics of Life*. Glencoe, 1995.

Organizations:

Legacy Inc., P.O. Box 3813, Montgomery, AL 36109; telephone (334) 270-5921. This organization has activities and information on all areas of environmental science.

Gone Fishing

(Student Handout)

Purpose: To see how biotic and abiotic factors affect an eagle population

Background:

If resources were unlimited and environmental conditions were ideal, a population would continue to increase in size. This rarely happens because resources are limited and conditions are not ideal. The maximum number of organisms that an area can support is called its carrying capacity. In nature, many populations remain below the carrying capacity because of both living (biotic) and nonliving (abiotic) factors. These factors include climate, habitat, available food, water supply, pollution, and disease as well as interactions between species such as predation, parasitism, and competition. The interactions between a population and the components of an ecosystem are complex. What kind of effects do competition, insecticides, pollution, frozen lakes, or a drought have on an eagle population?

Materials:

Index card
Uncooked yellow rice grains (75)
2 grids (hunting grid and lake grid)
Uncooked white rice grains (150)
Metric ruler
Scissors
Graph paper
Colored pencils (6 colors)

Safety Considerations: Always wear goggles in the lab. Do not eat the rice grains. Be careful with scissors.

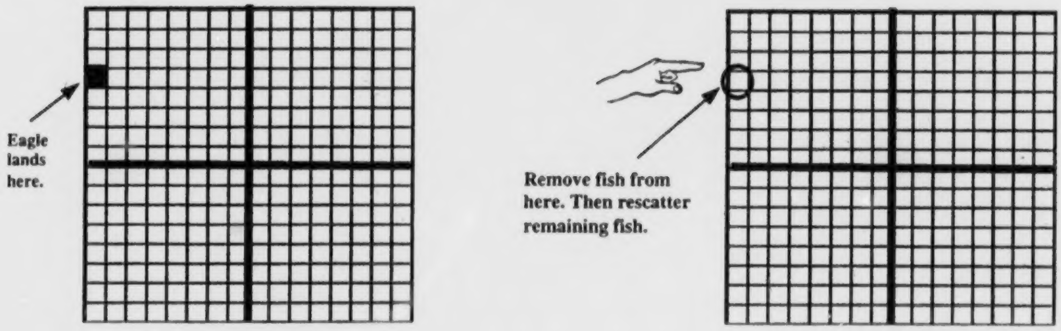
Procedure:

Part 1

Eagles mate for life. Only one pair of eagles will occupy, defend, and hunt within a well-defined territory.

1. The two grids provided represent a 4-km^2 lake (10 cm = 1 km) where the eagles hunt for fish. This will be their only source of food.
2. Cut two 1-cm squares from the index card. Label one of the squares M for male and the other F for female.
3. Lay the two grids near each other on a flat surface. Scatter 150 grains of white rice over one of the grids. This grid represents the lake, and the rice represents the large fish swimming in the lake. The eagles will eat only the large fish.
4. The other grid is the hunting grid. Hold the M (male eagle) square over the hunting grid. Let it fall onto the grid.
5. Note the location of where the M landed on the hunting grid. Remove all the rice from the corresponding square on the lake grid. Do the same with the F square. This process represents the eagles catching fish. See Figure 1.

Figure 1.



Hunting Grid

Lake Grid

6. Each adult eagle hunts for food twice a day. Rescatter the remaining rice and repeat Steps 4 and 5. Total the number of fish eaten by both the male and female eagles on Day 1. Record this total in Table 1 under Day 1.
7. Repeat Steps 4 - 6 nine more times and be sure that you record the total number of fish caught on each day in Table 1. The fish population will not increase at this time since this is taking place in the fall. An adult eagle must eat a total of nine fish within a three-day period. If it does not, it will soon grow too weak to hunt and will die. Be sure to examine the data for each three-day period as you continue. If one eagle dies, continue hunting with only one eagle for the remaining days.
8. Using one of the colored pencils, graph the daily total number of fish from Table 1. Record the days on the horizontal axis and the number of fish on the vertical axis. Answer Questions 1 and 2 in the lab report.
9. Imagine what would happen if two other birds of prey also hunted in the same lake with each one catching about three fish per day. Form a hypothesis to describe what effect this could have on the eagle population. Write the hypothesis in the space provided.
10. Return all the white rice to the lake grid. Repeat Steps 4 - 8 but this time randomly remove an additional six fish per day, which will represent the six total fish caught by the two ospreys that moved in. Record these totals in Table 2.
11. Using a different colored pencil, graph the daily total number of fish from Table 2. Answer Question 3 in the lab report.

Part 2

1. Rescatter all the rice as before.
2. There are other factors in the ecosystem that will affect the fish population. Any change in the fish population will, in turn, also affect the eagle population. Read and follow the directions given for Factor A. The teacher also will assign three other factors from the list below for you to work through. Follow the directions given for each factor assigned. Record the totals in Tables 3, 4, 5, and 6, making sure each table is labeled properly. Also, answer the questions for the factors assigned under Activity on the lab report. Be sure to rescatter the remaining rice before each hunting trip. Also, be sure to return all the rice to the lake grid each time before beginning work with a new factor.

FACTORS

A. Insecticides are being used in an area close to the ecosystem. Smaller fish in the lake eat some of the insects that have ingested the insecticides. The larger fish, in turn, eat these smaller fish. The insecticides are then passed along to the eagles if they eat these fish. The insecticide causes the eagles to lay eggs that do not hatch. Replace 75 fish (white rice) with 75 contaminated fish (yellow rice). Repeat Steps 4 - 6 from Part 1 ten times. Graph the daily totals from the table making sure to use a different colored pencil. Answer Questions 1 and 2.

B. It is now spring, and the fish in the lake are spawning. Show this by doubling the number of fish. Repeat Steps 4 - 6 from Part 1 ten times. Graph the daily totals again using a different colored pencil. Answer Question 3.

C. It is winter, and the eagles cannot catch any fish because the lake is frozen over. Answer Question 4.

D. It is now summer and very hot and dry. A drought occurs causing the water level to fall. One-fourth of the fish die as a result. Simulate this by removing 38 fish from the lake. Then repeat Steps 4 - 6 from Part 1. Graph the daily totals and answer Question 5.

E. The lake becomes polluted with phosphates. These phosphates cause the algae in the lake to grow out of control reducing the amount of dissolved oxygen in the water. Three-fourths of the fish die as a result. To simulate this, remove 112 fish and then repeat Steps 4 - 6 from Part 1. Graph the daily total and answer Question 6.

F. The eagles have two offspring. This means that the adults must catch two additional fish per day to feed their offspring. Repeat Steps 4 - 6 from Part 1. Graph the daily totals and answer Question 7.

Part 3

1. Check data to see if it supports the hypothesis.
2. Be ready to share information with the class.

(adapted from Biology: The Dynamics of Life Lab Manuel)

Name __________________
Name __________________

LAB REPORT

Part 1

Table 1

Day	1	2	3	4	5	6	7	8	9	10
No. of fish										

1. How will eagle predation affect the fish population over time?

2. Describe the effects, if any, that a small decrease in the fish population could have on the eagle population.

Hypothesis:

Table 2

Day	1	2	3	4	5	6	7	8	9	10
No. of fish										

3. Describe what could happen over time to the eagle population if the eagles have to compete with other birds of prey for food.

Part 2

Table 3 *FACTOR: _A_*

Day	1	2	3	4	5	6	7	8	9	10
No. of fish										

4. Does the insecticide have any effect on the fish population? Why or why not? Does the insecticide have any effect on the eagle population? Why or why not?

5. Can pollutants, such as insecticides, affect one population in an ecosystem and not another?

Table 4 ***FACTOR:*** ___

Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
No. of fish										

Table 5 ***FACTOR:*** ___

Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
No. of fish										

Table 6 ***FACTOR:*** ___

Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
No. of fish										

FACTOR B QUESTION

1. What might happen to the eagle population if the fish population increases?

FACTOR C QUESTION

2. How could a seasonal change affect the eagle population?

FACTOR D QUESTION

3. Will climate changes always affect a population such as the eagle population? Explain the answer.

FACTOR E QUESTION

4. How was the eagle population indirectly affected by the phosphate pollution?

FACTOR F QUESTION

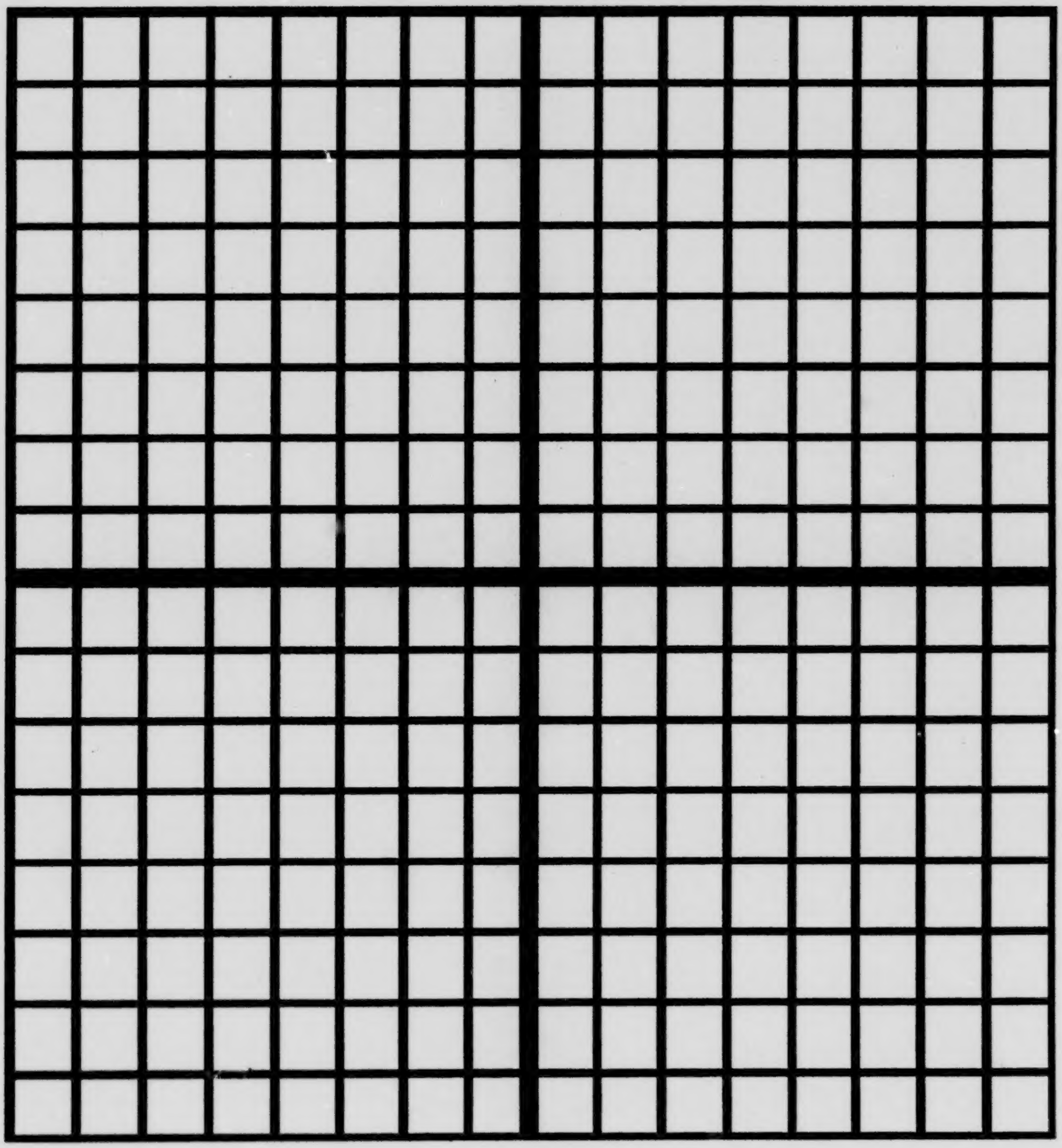
5. How would an increase in the eagle population affect the fish population?

Part 3: Checking the hypothesis

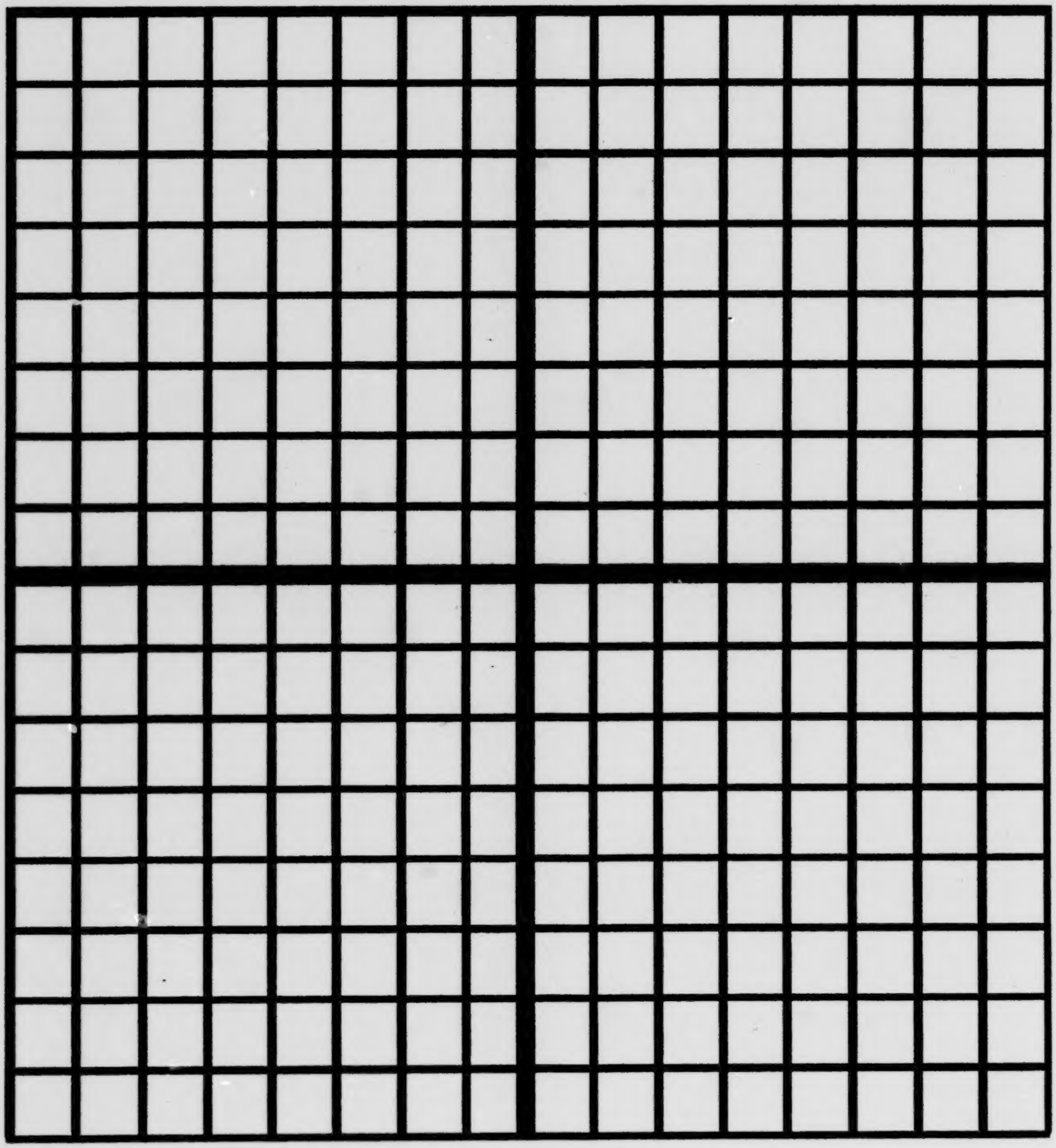
Was the hypothesis supported by data? Why or why not?

BE READY TO SHARE YOUR INFORMATION WITH THE CLASS.

Hunting Grid



Lake Grid



Osmosis in Purple Onion
(Teacher Notes)

Standard-Objective-Eligible Content: V-1, a (See pages B-2 - B-10.)

Lab Time: 30 minutes

Background: See student handout.

Materials:
Goggles

Pre-Activity:
Prepare a 10% salt solution. Review with students the definition of solution, solute, and solvent. Discuss and define osmosis. The movement of the water through the membrane is illustrated in the activity. The process of movement from an area of greater water concentration to an area of lesser water concentration will be observed.

Activity:
Circulate the room while students are using scalpels. Help students with microscope work as needed. Students should see the cells shrink as the salt water surrounds them. The cell membrane will pull away from the cell wall, and the cytoplasm will round out. As the distilled water is introduced, cells will take on water again and will fill back out to the cell wall.

Student Questions and Answers:
1. What did you observe when you placed the onion piece in the salt solution*? The onion cells in the salt solution shrink; their cytoplasm pulls away from the cell wall.*
2. What did you observe when you added the distilled water*? Water will diffuse into the cells and the cytoplasm expands.*
3. What can you infer about the movement of water between cells and their external environment? *Students may infer that water diffuses either way across the membrane; cells respond to their environment.*
4. Why do plants wilt*? When plants do not get enough water, the cells shrink and plants lose their rigidity.*

Additional Questions:
1. Why would drinking distilled water not be a good idea?
2. Why does grass wilt if too much fertilizer is applied to it?

Extensions:

Students can extend their understanding of osmosis by discussing what determines the net direction in which the water molecules diffuse across the cell membrane. This will give them a better understanding of the prefixes hypo-, hyper-, and iso- referring to relative concentration of solutions. Therefore, water will diffuse into and out of the cell at equal rates, thereby establishing osmotic balance.

Direction of Osmosis

Conditions	**Environment solution is**	**Cell solution is**	**Water**
If a solute concentration in the environment is lower than in the cell,	Hypotonic.	Hypertonic.	will move into the cell.
If a solute concentration in the environment is higher than in the cell,	Hypertonic.	Hypotonic.	will move out of the cell.
If a solute concentration in the environment is equal to that in the cell,	Isotonic.	Isotonic.	is balanced.

Reading Comprehension Connection: I-3, II-2, 3 (See page B-11.)

Resources:

Book:

Johnson, George B. and Peter H. Raven. *Biology Principles & Explorations.* Holt, Rinehart and Winston, 1996. pp. 58-61.

Internet:

Think Quest's Osmosis

http://tqd.advanced.org/3542/experiments/osmosis.html

Osmosis in Purple Onion

(Student Handout)

Purpose: To observe the process of water movement through a living membrane

Background:

A substance that dissolves in another substance is called a solute, and the more plentiful substance that does the dissolving is called the solvent. In living things, water is the solvent. The mixture of solute and solvent is called a solution. Solute and solvent tend to diffuse from areas where their concentration is high to areas where their concentration is lower. When water moves from higher concentration of water to lower concentration of water through a cell membrane, it is called **osmosis**.

Materials/Equipment:

10% salt solution
Distilled water
Piece of red onion
Pipette or medicine dropper
Microscope slide
Coverslip
Single-edge razor blade or scalpel
Microscope

Safety Considerations: Wear goggles in the lab while cutting the onion. Follow all other lab safety procedures.

Procedure:

1. Take a small piece of onion and peel off a sheet of the purple skin. Cut a piece of skin about the size of a little fingernail.
2. Place a drop of 10% salt solution on a microscope slide. Place the piece of onion over the drop and cover with a coverslip.
3. Using the low-power objective, observe the slide using the microscope.
4. Record observations.
5. Use a clean dropper to add distilled water to one side of the coverslip. Place a small piece of paper towel on the opposite side to absorb the salt solution on the other side.
6. Observe the onion cells and record the observations.
7. Clean and dry slide and coverslip.

Questions:

1. What did you observe when you placed the onion piece in the salt solution?
2. What did you observe when you added the distilled water?
3. What can you infer about the movement of water between cells and their external environment?
4. Why do plants wilt?

Plant and Animal Cells
(Teacher Handout)

Standard-Objective-Eligible Content: I-c (See pages B-2 - B-10.)

Lab Time: 50 minutes

Background: See student handout.

Materials: See student handout.

Pre-Activity:
Prior to the lab, discuss the importance of the microscope to biology and the reasons it is such an indispensable instrument in the study of life. Students should have a previous lab in which they have had the opportunity to use a microscope.

Post-Activity:
Have students discuss the differences in the two plant cells and the ways they compare to the animal cells.

Student Questions and Answers:
1. Is there a single layer of cells or many layers in the *Callisia elegans* slide? *Many layers*
2. What geometric figure best describes the shape of a *Callisia elegans*? *Hexagon (shape of a stop sign)*
3. What occupies the center of the cell? *Cytoplasm*
4. Where is the cell membrane located? *Outer edge*
5. What occupies the greatest volume in the onion epidermal cell? *Cytoplasm*
6. Compare green and nongreen plant cells with animal cells by placing checks in the spaces below to indicate the presence of the cellular components.

Cell Components	Green Plant Cells	Nongreen Plant Cells	Animal Cells
Cell Wall	X	X	
Nucleus	X	X	X
Large Central Vacuole	X	X	
Cell Membrane	X	X	X
Cytoplasm	X	X	X
Chloroplast	X	X	

7. What three components listed in Question 6 are present in both plant and animal cells? *Nucleus, cell membrane and cytoplasm*
8. What cytoplasmic component is found only in green plant cells? *Chloroplast*
9. What three structures distinguish plant cells from animal cells? *Large central vacuole, cell wall, chloroplast*
10. State the cell theory. *All living things are composed of one or more cells or cell fragments. The cell is the basic unit of structure and function in living things. All cells are produced from other living cells.*

11. Place the letter of the correct response in the space provided.

e Cell wall
f Cytoplasm
b Cell membrane
c Central vacuole
a Chloroplasts
d Nucleus

a. contain chlorophyll
b controls entrance and exit of substances to and from the cell
c. fluid-filled cavity in plant cells
d. control center of the cell
e. rigid, nonliving structure giving support to plant cells
f. the gelatin-like substance that surrounds the organelles

12. Define tissue, organ, organ system.

tissue - group of cells with a common structure and function
organ - collection of tissues that work together to perform a particular function
organ system - group of organs that function together to carry out a major activity of the body

Extensions:

The student could construct a model of either a plant or animal cell. The class could be divided so that some of the class would make plant cells and others make animal cells. This could be done as an edible lab with students using rectangle cakes to represent plant cells and a round cake to represent animal cells. Students would use various edible items to represent the organelles. This is best done with the cakes prepared in advance. Students can write a key card showing what item represents which organelles. Examples for organelles are candy or fruit.

Simulated cells could be constructed using paper plates as the cell and pasta and/or dried vegetables representing organelles.

Reading Comprehension Connection: I-2 and 3; II-2 and 3 (See page B-11.)

Resources:

Books:

Miller, Kenneth R. and Joseph Levine. *Biology*. Prentice Hall. 1993. pp. 89-98.
Morrison, Earl S. and Alan Moore. *Science Plus Level Green*. Holt, Rinehart and Winston, 1997. pp. 116-119.
Towle, Albert. *Modern Biology*. Holt, Rinehart and Winston, 1993. p. 77.

Plant and Animal Cells

(Student Handout)

Purpose: To identify and define similarities and differences between plant and animal cells

Background:
Plant and animal cells are similar in many ways and contain most of the same organelles. There are some differences between them that can be discovered during the observations in this lab.

Materials/Equipment:

Pipette
Water
Glass slide
Coverslip
Onion
Forceps
Microscope
Lens paper
Flat toothpicks
Methyl blue stain - 10%
Callisia elegans (striped inch plant)
Single-edge razor blade

Safety Considerations: Always follow lab safety procedures.

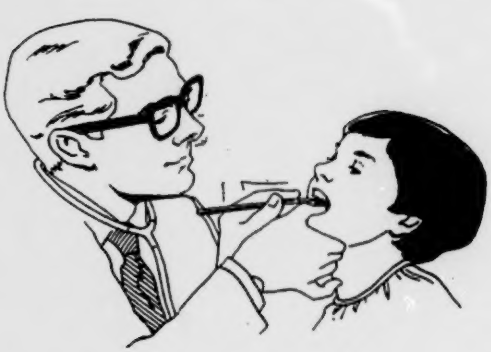
Procedure:

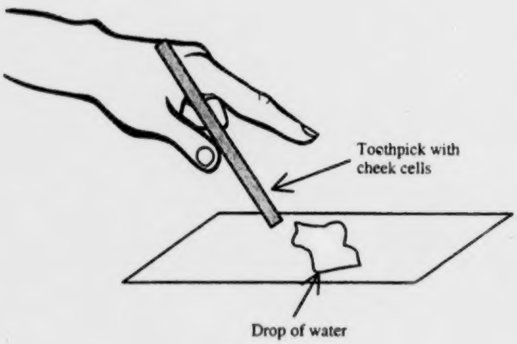
Part A - Examining Plant Cells

1. Using both hands, carefully handle the microscope, and place on a flat surface.
2. Clean the eyepiece and objective lens with lens paper.
3. Place a drop of water on a clean slide.
4. Using the forceps, remove the thin membrane between the onion layer and place on the drop of water. Make sure that the membrane is flat.
5. Carefully place a coverslip over the drop of water and onion. Using a piece of paper towel, the student may need to remove excess water. (Caution: Student may need to put slide on a flat surface and apply a small amount of pressure to remove air bubbles.)
6. Using the low power, locate the specimen on the slide. Focus and sketch an onion cell.
7. Switch to high power and compare with the low-power sketch.
8. Redraw and label the parts that are listed in the cell components' chart.
9. Repeat the procedure using a small section of the *Callisia elegans*, which has been cut from the leaf.
10. Note the difference in the cell wall shape.
11. Identify the structures found in the living cell, i.e., different colors of chloroplast. Note the stomata (the lip-like structures).
12. Sketch and label the *Callisia elegans* cell. Record the magnification of the microscope at the power used for the sketch.

Part B - Examining Animal Cells

1. Place a drop of methyl blue stain in the center of a clean slide.
2. Using the flat end of a toothpick, gently scrape the inside of your cheek. (Figure 1)
3. Stir the toothpick around in the drop of stain. Dispose of the toothpick. (Figure 2)
4. Cover the slide with a coverslip.
5. Using the low-power objective lens, locate a few cheek cells. (You may need to reduce the amount of light to be able to view the cells.)
6. Switch to high-power. Observe the cheek cells and sketch. Record the power of magnification.
7. Carefully clean and dry the slides and coverslips.





Questions:

1. Is there a single layer of cells or many layers in the *Callisia elegans* slide?
2. What geometric figure best describes the shape of a *Callisia elegans*?
3. What occupies the center of the cell?
4. Where is the cell membrane located?
5. What occupies the greatest volume in the onion epidermal cell?
6. Compare green and nongreen plant cells with animal cells by placing checks in the spaces below to indicate the presence of the cellular components.

Cell Components	Green Plant Cells	Nongreen Plant Cells	Animal Cells
Cell Wall			
Nucleus			
Central Vacuole			
Cell Membrane			
Cytoplasm			
Chloroplast			

7. What three components listed in Question 6 are present in both plant and animal cells?
8. What cytoplasmic component is found only in green plant cells?
9. What three structures distinguish plant cells from animal cells?
10. State the cell theory.
11. Place the letter of the correct response in the space provided.

    ______ Cell wall a. contain chlorophyll
    ______ Cytoplasm b controls entrance and exit of substances to and from the cell
    ______ Cell membrane c. fluid-filled cavity in plant cells
    ______ Central vacuole d. control center of the cell
    ______ Chloroplasts e. rigid, nonliving structure giving support to plant cells
    ______ Nucleus f. the gelatin-like substance that surrounds the organelles

12. Define tissue, organ, organ system.

Poor Primitive Prokaryotes
(Teacher Notes)

Standard-Objective-Eligible Content: V-1, d (See pages B-2 - B-10.)

Lab Time: approximately 50-60 minutes or 1 class period

Background: See student handout.

Materials:
Index cards (12 per group of 4 students)
1 poster or butcher paper
1 metric ruler per group
String or twine for students to measure and serve as radius to draw game circle

Pre-Activity: (10-15 minutes)

1. As groups divide responsibility for descriptions of cell components, tell them to include a simple sketch of that component as well, especially if this activity is the foundation for further cell studies.
2. The string may be used as the radius for drawing the circle for the game board.

Activity: (15-20 minutes)

1. During the game play, circulate among groups to assess appropriate selection and/or justifications for changing a placement.
2. When called to review a group's cell pie, reveal only the total number in each of the three segments that have been incorrectly placed. Pose questions or direct attention to guide students toward more accurate responses.

Post-Activity: (15-20 minutes)

1. Circulate again to determine appropriate components included in drawings.
2. Discuss the post-activity questions and allow groups to explain their responses.

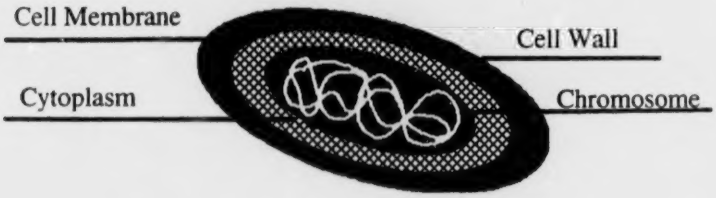
Sample Data and Calculations:

Components in the "P" section = none

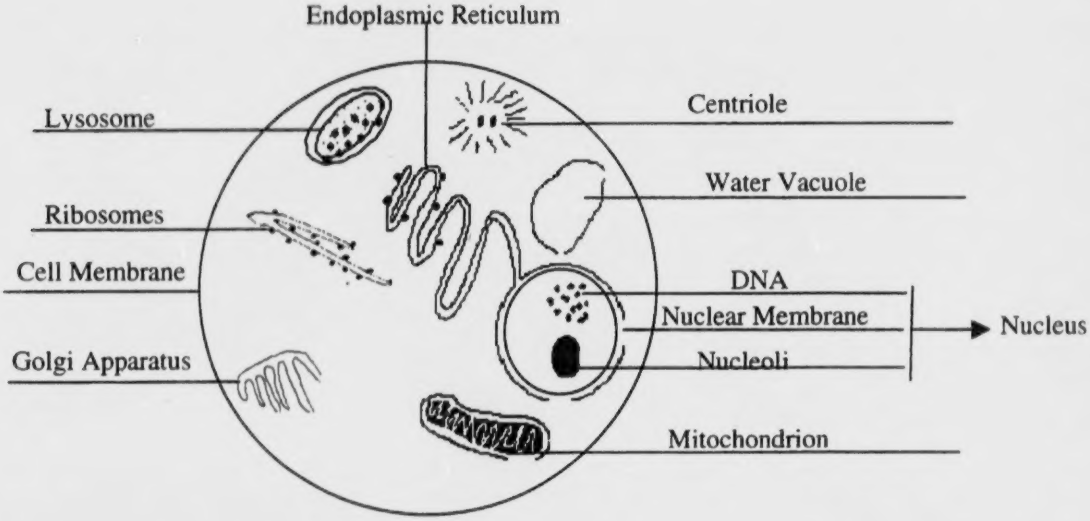
Components in the "E" section = nuclear envelope, vacuoles, endoplasmic reticulum, mitochondria, lysosomes, Golgi bodies, nucleolus

Components in the "B" section = cell wall, cell membrane, DNA/chromosome, cytoplasm, ribosomes

Prokaryote Cell


Cell Membrane
Cell Wall
Cytoplasm
Chromosome

Eukaryote Cell


Endoplasmic Reticulum
Lysosome
Centriole
Water Vacuole
Ribosomes
Cell Membrane
DNA
Nuclear Membrane
Nucleus
Golgi Apparatus
Nucleoli
Mitochondrion

Student Questions and Answers:

1. Use the drawings and the lab chart to explain why prokaryotic cells are considered more primitive than eukaryotic cells. *Strong biochemical and fossil evidence indicates that prokaryotes were the earliest life forms on Earth. The separation and specialization of certain chemical activities into membrane-bound compartments (organelles) is considered an evolutionary advance in the eukaryote cells.*
2. Scientists have noticed that certain organelles strongly resemble the primitive prokaryote cells. Which cell part (organelle) of the eukaryote cell looks the most like a bacteria cell? *The double-membrane bound mitochondria and chloroplasts each have their own DNA and strongly resemble prokaryote bacteria cells.*

Additional Questions:

1. Why have bacteria been placed in the kingdom Monera?
2. What specialized function does each membrane-bound organelle perform within an eukaryotic cell?

Extensions:

This activity could easily form the basis for further comparisons of plant vs. animal cells. Another extension would be the evolutionary development of cells, i.e. endosymbiosis theory (Margulis's Theory).

Reading Comprehension Connection: I-3 (See page B-11.)

Resources:

Internet:
University of Wisconsin-Madison, Microbology for the General Public
http://www.bact.wisc.edu/MicroTextbook/BacterialStructure/siteoutline.html
Access Excellence High School Biology - Cell Organelles-Joyce R. Calo
http://www.gene.com/ae/AE/AEC/AEF/1996/calo_cell.html
Access Excellence High School Biology - The Cell-Lisa Fernandez
http://www.gene.com/ae/AE/AEC/AEF/1996/fernandez_cell.html

Poor Primitive Prokaryotes

(Student Handout)

Purpose:. To identify and define similarities and differences between prokaryotic and eukaryotic cells

Background:

Cells are the basic units of life. New and better instruments, such as electron microscopes, have allowed scientists to study the structure of living cells in increasing detail. In doing so, it was discovered that there are two basic kinds of cells: prokaryotic and eukaryotic.

Prokaryotic cells do not have a nucleus or any internal membrane-bound structures. Within these cells, membranes do not separate different areas from one another. Bacteria in the Kingdom Monera are prokaryotes. There are some universal structures that all bacteria have. Like every living organism, they have the basic building blocks of life -- DNA, RNA, and protein. Therefore, these prokaryote cells will generally have an area of genetic material but no nuclear membrane. They will also have RNA and free-floating ribosomes for protein synthesis. In addition, all bacteria have a cell membrane, and most have a cell wall outside that. Since prokaryotic means "without or before nucleus," it may help to remember them as the POOR, PRIMITIVE PROKARYOTES. (*Pro* means before and *karyote* means nucleus.)

In contrast, eukaryotic cells have many kinds of internal membrane-bound structures called organelles. Essentially then, eukaryotes have EVOLVED EVERYTHING IN ENVELOPES. The most important of these is the nucleus where the hereditary DNA is separated. Compared to prokaryotes, eukaryotes are much more compartmentalized and specialized. Eukaryotic cells are present in all living things except bacteria that would include protists, fungus, plant, and animal cells. (*eu* means true and *karyote* means nucleus.)

The following activity will provide practice in recognizing the similarities and differences between prokaryotes and eukaryotes.

Materials/Equipment:

Index cards
Poster paper
Metric ruler
String

Safety Considerations: Always follow lab safety procedures.

Pre-Activity:

1. Divide the cell structures listed on the observation Data Table among the group members. Use descriptions and diagrams from the text to write a brief summary on an index card to describe the nature of that cell part.
2. Draw a circle with a 25cm radius on the poster board. Divide the circle into three equal segments labeling the sections as "P," "E," and "B."

Activity:

1. When all cards have been prepared, shuffle them and place the stack face down in the center of the circle.

2. Take turns having a group member draw a card from the center, read its description aloud, and place it into one of the three pie segments. If the cell part would only be found in prokaryote cells, the card should be placed in the "P" segment. If the cell part would be found in eukaryote but not in prokaryote, then the "E" segment should be chosen. However, if the cell part would be common to all cells, the card should be placed in the "B" segment for both.
3. Once the card has been played, the group has the opportunity to agree or disagree with the decision. Another group member may move the card but must justify the new placement. Play resumes in a counter-clockwise fashion until all cards have been placed.
4. Ask the teacher to review the cell pie. If all of the selections were correct, mark them on the Data Table.
5. If cards have been incorrectly placed, the teacher will reveal only the number in each segment that should be reevaluated. The group may discuss these, make new placements, and ask for another review until all are accurately arranged. Post these corrected selections in the Data Table.

Post-Activity:

1. Using the table and samples from the text, draw and label the components of a typical prokaryotic cell and of an animal eukaryotic cell. (Note: Don't forget the "B" items in the sketches.)

Data Table:

CELL	**TYPE**		**CELL STRUCTURES**
"P"	**"E"**	**"B"**	
			Cell Wall
			Cell (plasma) Membrane
			DNA/Chromosome
			Nuclear Envelope or Membrane
			Cytoplasm or Protoplasm
			Vacuoles
			Endoplasmic Reticulum (ER)
			Golgi Bodies
			Mitochondria
			Ribosomes
			Lysosomes
			Nucleolus (RNA)

Sketch of Prokaryote cell (bacteria) **Sketch of Eukaryote cell (animal)**

Questions:

1. Use the drawings and the lab chart to explain why prokaryotic cells are considered more primitive than eukaryotic cells.
2. Scientists have noticed that certain organelles strongly resemble the primitive prokaryote cells. Which cell part (organelle) of the eukaryote cell looks the most like a bacteria cell?

Window Cells
(Teacher Notes)

Standard-Objective-Eligible Content: V-1, f and g (See pages B-2 - B-10.)

Lab Time: 50 minutes

Background: See student handout.

Materials: See student handout.

Pre-Activity:
Hang one large sheet of bulletin board paper per group on the wall. These should be scattered around the room. Poster board or pieces of white cloth (sheets) could be used instead of bulletin board paper. Title half of these "plant cell" and the other half "animal cell." Using a black marker, draw an outline of either a plant or animal cell on each sheet. Provide students with a handout of specified organelles that the students will be asked to identify and draw. Allow a team leader for each group to select a card that reads either "p" for plant or "a" for animal. This represents which type of cell they will display.

Ensure that students are familiar with the terminology of the two cell types (prokaryotic and eukaryotic), the kinds of cells (plant and animal), and the organelles found in each. Ask students to complete the handout on organelles while using their class notes. Determine whether an organelle is found in the plant cell, animal cell, or both. Have students draw a sketch of their cell with the appropriate number of organelles for them to use as a guide. Divide the classroom into either two large groups or four smaller groups.

Activity:
1. Have students draw each organelle on a sheet of construction paper.
2. Have students color and label each drawing.
3. Have students cut out each drawing.
4. Have students affix the drawings and labels to the large sheets of paper in the positions where they normally would be found in the cell.
5. Monitor students to ensure that the size of the organelles is appropriate for the size of the cell.

Post-Activity: Have students develop a concept map showing how the organelles interact.

Student Questions and Answers:
1. What are the differences between animal and plant cells? *The difference between plant and animal cells lies within the organelles that are found in each. Plant cells contain cell walls, chlorophyll, and chloroplasts. Animal cells do not. Plant cells also have only a few very large vacuoles; animal cells have several smaller vacuoles.*
2. Which organelle is considered to be the "brain" of the cell? *The nucleus*
3. Which organelle is the powerhouse of the cell? *The mitochondria*
4. Which organelle is considered to be the transportation system of the cell? *The endoplasmic reticulum*

Additional Questions:

1. Name five organelles found in cells and describe how each enables the cell to display the properties of life. (Example: Protein Synthesis)
2. Give evidence that suggests eukaryotes evolved from prokaryotes.

Extensions:

1. Have students present their cell displays to the other groups in the classroom.
2. Have students write a short essay contrasting the efficiency of small cells to large cells.

Reading Comprehension Connection: I-2; II-3; IV-1 (See page B-11.)

Resources:

Book:

Johnson, George B. *Biology: Visualizing Life.* Holt, Rinehart and Winston, Inc., 1994. pp. 56-66.

Internet:

Cells on Ceiling. Katheryn S. Hopkins
http://www.gene.com/ae/AE/AEC/AEF/1994/hopkins_cells.html

Window Cells
(Student Handout)

Purpose: To be able to visualize and compare plant and animal cells and to be able to recognize organelles and understand their functions

Background:
According to the cell theory, the cell is the basic unit of life of all organisms. This characteristic is shared by all organisms whether it is simple, like a bacterium, or complex, like a human. There are two types of cells: prokaryotic and eukaryotic. Prokaryotic cells have no true organelles and are much smaller than eukaryotic cells. Eukaryotic cells have organelles such as the nucleus, mitochondria, and ribosomes. Organelles have specific roles much like the parts of a car. Just as no car could function properly without a battery, engine, wheels, starter, etc., neither could the cell. All of the parts must work together.

Materials: (per group)
15 sheets of construction paper (assorted colors)
Colored pencils, crayons, or markers
Tape, glue, or glue sticks
1 large piece of bulletin board paper, cloth, or poster board
Scissors
Paper
Textbook

Safety Considerations: Always follow lab safety procedures.

Procedure:
1. Research the functions of the organelles found within plant and animal cells.
2. Complete the Cell Parts and Function handout and answer questions.
3. On a sheet of paper, draw a sketch of the type of cell the leader chooses.
4. Determine which organelles should be included in the cell display.
5. Determine the size of the organelles for the display.
6. Determine how many of each organelle are needed for the display.
7. Draw, color, cut out, and label each organelle.
8. Affix the organelles to the large poster board on the walls.

Data Table:

Cell Parts and Function Handout

CELL PART	CELL FUNCTION
1. Cell wall	
2. Cell membrane	
3. Nucleus	
4. Cytoplasm	
5. Vacuole	
6. Nucleolus	
7. Ribosomes	
8. Mitochondria	
9. Golgi Bodies	
10. Chloroplasts	
11. Chlorophyll	
12. Lysosome	
13. Microtubules	
14. Smooth Endoplasmic Reticulum	
15. Rough Endoplasmic Reticulum	

Questions:

1. What are the differences between animal and plant cells?
2. Which organelle is considered to be the "brain" of the cell?
3. Which organelle is the powerhouse of the cell?
4. Which organelle is considered to be the transportation system of the cell?

Mitosis and Meiosis Motion Picture Flip Books
(Teacher Notes)

Standard-Objective-Eligible Content: V-2, a and b (See pages B-2 - B-10.)

Lab Time: 40 minutes

Background: See student handout.

Materials: See student handout.

Pre-Activity: (5 – 10 minutes)
The time for cutting the paper into pieces can be reduced with a paper cutter. Review mitosis and meiosis with the students and help them if they get confused.

Answers to the Pre-Activity

Characteristics	Mitosis	Meiosis
Used to produce growth in an organism	X	
Used for sexual reproduction		X
Used for the repair of damaged cells	X	
Begin with 46 chromosomes and end with two cells each with 46 chromosomes.	X	
Begin with 46 chromosomes and end with 23 chromosomes in each cell.		X

Activity: (30 minutes per flipbook)
Make sure the students understand that they will have four or five pages that are actually the same stage (beginning prophase, middle prophase, late prophase, etc.). Make sure the students draw the cell in the same way and in the same place on each piece of paper so it will look like a motion picture when they are finished. If time is limited, half of the class can do mitosis and the other half, meiosis. They can then share and compare the processes. More slips of paper will be necessary since meiosis has more steps. They will not need all 30 sheets for mitosis.

Post-Activity:
Have students share their flipbooks.

Student Questions and Answers:

1. How many nuclei are produced during the process of mitosis? *Compare this to the number of nuclei produced in meiosis. 2, 4 (twice as many)*
2. Which process would the body use to repair a cut toe? *Mitosis (Point out to students that "toe" sounds like it goes in mitosis, and this is a way to remember which process goes with which function.)*
3. What happens to the double-stranded chromosomes during mitosis? Compare this to what happens to the double-stranded chromosomes during meiosis. *They separate. They stay together.*
4. Which process would be used to make sperm cells? *Meiosis*

Reading Comprehension Connection: I-2; IV-3 (See page B-11.)

Resources:
Internet:
University of Arizona tutorial
http://www.biology.arizona.edu/cell_bio/tutorials/meiosis/page4.html

Mitosis and Meiosis Motion Picture Flip Books
(Student Handout)

Purpose: To compare and contrast the processes of mitosis and meiosis

Background:
Mitosis and meiosis (also known as reduction division) are different processes by which cells reproduce. Cells within a plant or animal are constantly undergoing these processes to replace worn-out cells, grow, and produce offspring. Humans have 46 chromosomes in each somatic (regular body) cell. Since that is **double** the number of chromosomes found in gametes (sex cells), we refer to it as the **diploid** number. The number of chromosomes found in gametes is 23. Since it is **half** the number in the somatic cell, it is called the **haploid** number of chromosomes.

Put a check in the box for the process used in each example:

Characteristics	Mitosis	Meiosis
Used to produce growth in an organism		
Used for sexual reproduction		
Used for the repair of damaged cells		
Begin with 46 chromosomes and end with two cells each with 46 chromosomes.		
begin with 46 chromosomes and end with 23 chromosomes in each cell.		

Materials/Equipment: (per student per booklet)

5 sheets of white paper (copy paper is fine). You can make these flipbooks smaller to save paper if needed.
1 set of colored pencils or crayons per student
1 textbook with the stages of mitosis and meiosis in it per student
1 stapler for the whole class
1 pair of scissors for every 1 or 2 students

Safety Considerations: Always follow lab safety procedures.

Procedure:
This activity will be done individually.

1. Get the materials from the teacher. Cut 30 small pages for each flipbook. They should be about 6" x 4." Make them all the same size in order for someone to easily flip through the book,
2. Look at a diagram of the stages of MITOSIS in the textbook. The names of the stages are not important for this activity, just the pictures of what is happening inside the cell.
3. Use colored pencils or a regular pencil and crayons to draw the changes that take place as a cell divides. The pictures should be drawn close to the free edge of the pad, in order for them to be visible when the pages are flipped.
4. Each page should vary only slightly from the preceding one to show the very gradual changes that take place inside the nucleus of the cell. No words are necessary.

5. After drawing and coloring the flipbook for mitosis, make a cover for it to include the following.
   Mitosis
   Used for growth and repair of cells
   Begin with 46 (diploid number) chromosomes in each human cell and end with 46 (diploid number) of chromosomes per cell.
   The way regular human body cells (not gametes) reproduce
6. Staple the book together.
7. Repeat Steps 1-7 to make another flipbook for the process of MEIOSIS. Include the following on the cover of the meiosis flipbook.
   Meiosis
   The way human gametes (sex cells) are formed
   Begin with 46 chromosomes in a human cell and end up with 23 chromosomes (haploid number) in each cell.
8. Enjoy your motion picture cell reproduction flipbooks!

Questions:

1. How many nuclei are produced during the process of mitosis? Compare this to the number of nuclei produced in meiosis.
2. Which process would the body use to repair a cut toe?
3. What happens to the double-stranded chromosomes during mitosis? Compare this to what happens to the double-stranded chromosomes during meiosis.
4. Which process would be used to make sperm cells?

Owl Pellets
(Teacher Notes)

Standard-Objective-Eligible Content: VI-1, f (See pages B-2 - B-10.)

Lab Time: 35 to 40 minutes

Background: See student handout.

Materials: See student handout.

Pre-Activity:
Discuss with the students the prey-predator relationships and their affects on population dynamics and ecosystems.

Activity:
(Divide the students into small groups)
1. Give each group an owl pellet, supplies, and bone-sorting chart.
2. Measure the mass and dimensions of the pellet.
3. Have students match up the skeleton of the prey with animal consumed.
4. Skeletons may be glued on sheet.
5. Have group discussions of the predator and the way pellet was obtained.

Post-Activity: 15 minutes or more
1. Each group shows the number and type of skeletons retrieved from the pellet.
2. Discuss the role of predator/prey relationship in the ecosystem.

Student Questions and Answers:
1. What prey sources were found in the pellet? *Answers will vary depending on the skeletal remains in the pellet.*
2. What can be determined about the habitat from the analysis of the pellet? *Answers will vary.*
3. How can the decline of either the predator and/or the prey population affect the ecosystem? *Decline in predator population would tend to allow overpopulation of prey species resulting in disease and death of individual members. Decline in prey population would cause a decline in the predator numbers.*
4. What are causes for the population changes?
5. How do humans fit into the scheme?

Extensions:
1. Students could research a different predator/prey in the ecosystem
2. Research and report on the role of pesticides on the predator-prey relationship.

Reading Comprehension Connection: I-3 (See page B-11.)

Owl Pellets
(Student Handout)

Purpose: To show the relationships between predator and prey and to know how these relationships affect the ecosystem

Background:
In predations, one organism kills and eats another organism. The organism that is eaten is the prey, and the one that is eating is the predator. Predators are usually beneficial organisms. The predators prey on "surplus" animals and do not cause a serious decline in the prey population. Predators do not usually cause species extinction, and overpopulation of prey species may occur if numbers are not held in check by predator species.

Owls are nocturnal animals who feed on small rodents such as mice, moles, and small birds. The owl's digestive system is such that the owl pellet is regurgitated. These pellets will be used in the dissection.

Materials/Equipment:

Owl pellets
School glue
Gloves (optional)
Bone-sorting chart
Round toothpicks
Ruler
Paper plates

Safety Considerations: Always follow lab safety procedures.

Procedure:
1. Remove pellet from packaging.
2. Measure and record the mass of the pellet.
3. Measure and record the dimensions of the pellet.
4. Place the pellet on a paper plate.
5. Using the toothpick, carefully separate the bones from dried fur or feathers.
6. Carefully clean the bones and sort them according to type: skulls, jaws, vertebrae, etc.
7. After making sure all bones have been removed, discard fur and feathers.
8. Using a dot of glue, attach bones to the bone-sorting chart.

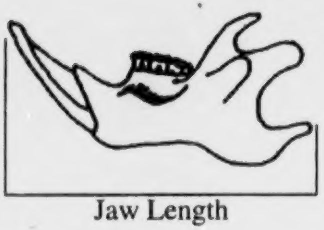
Data Table:

Pellet Mass (g)	Pellet Length (cm)	Pellet Width (cm)

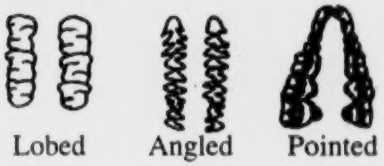
Questions:
1. What prey sources were found in the pellet?
2. What can be determined about the habitat from the analysis of the pellet?
3. How can the decline of either the predator and/or the prey population affect the ecosystem?
4. What are causes for the population changes?

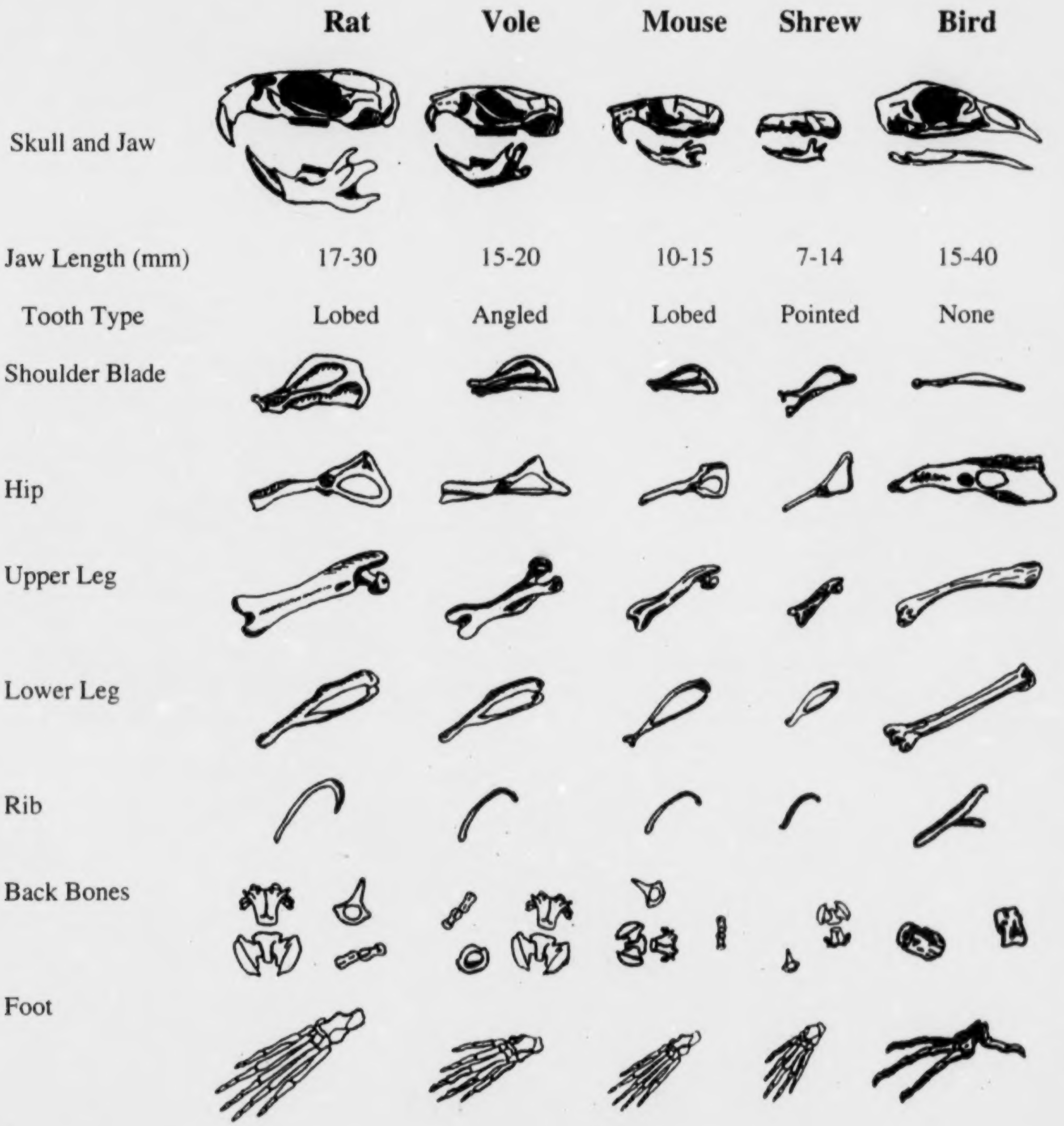
Identifying Owl Pellet Contents*

How to measure the jaw



Tooth types





	Rat	Vole	Mouse	Shrew	Bird
Skull and Jaw					
Jaw Length (mm)	17-30	15-20	10-15	7-14	15-40
Tooth Type	Lobed	Angled	Lobed	Pointed	None
Shoulder Blade					
Hip					
Upper Leg					
Lower Leg					
Rib					
Back Bones					
Foot					

* Reprinted with permission from White Owl Enterprises.

Energy Transfer
(Teacher Notes)

Standard-Objective-Eligible Content: VII-1, a and b; I-1, d and g (See pages B-2 - B-10.)

Lab Time: 45-60 minutes

Background: See student handout.

Materials/Equipment: See student handout.

Pre-Activity:
Discuss with students how heat is transferred and how energy transformations occur. Give examples of transformations and ask if they can give others. Have students read activity handout. Divide the class into cooperative groups and give each group materials for lab. Make sure all students understand that **no** power is connected until set up is complete and checked.

Activity:
This experiment should only be done if electrical outlets with GFI are available. After students set up droplight as directed, check to see that all connections are dry and secure before allowing power to be connected. Also check to see that hot lights are not touched by students or in contact with metallic objects. Be sure that temperature measurements are made and recorded on data table.

Post-Activity:
Have students record data and calculate the heat gained by the water. The questions should also be answered. Note that bulbs are not 100% in converting electrical energy to heat and light energy.

Sample Data and Calculations:

Distance to Light (cm)	Water Volume (mL)	Initial Water Temperature (°C)	Final Water Temperature (°C)	Time (seconds)
10	200	25	50	600
20	200	25	35	600

Heat absorbed by the water = Mass of the water x Specific heat of the water x **Change** in the water's temperature (Remember the density of water is 1g/mL and the specific heat of water is 4.18 J/g-°C.)

ΔH (10 cm height) = 200g x 4.18 J/g-°C x (50°C - 25°C)
= 20,900 J

ΔH (20 cm height) = 200g x 4.18 J/g-°C x (50°C - 35°C)
= 12,540 J

The heat energy released by the droplight remains the same at 10 cm or 20 cm. Assuming the bulb is 100% efficient in converting electrical energy to light and heat, the energy released is calculated as follows:

Energy (light and heat released) = Power x Time
E = 60 watts x 600 seconds
= 60 joules/second x 600 seconds
= 36,000 joules

The heat absorbed by the surroundings is the difference between the heat released by the light and the heat absorbed by the water.

ΔH (10 cm height) = 36,000 J - 20,900 J = 15,100 J
ΔH (20 cm height) = 36,000 J - 12,500 J = 23,500 J

Student Questions and Answers:

1. How is the distance between the light source and the water related to the amount of heat absorbed? *The heat absorbed by the water should decrease as the distance increases.*
2. How much of the energy given off by the light was not absorbed by the water? *Answers vary according to calculations.*
3. Where is the extra heat energy going? *Light and heat energy radiate in every direction away from the bulb. The energy that does not strike the water is absorbed by the rest of the surroundings: air, light housing, and any other matter close enough.*
4. Describe the energy transformations that occur from the potential energy of the source to the heat energy absorbed by the water. *For radiation to occur, heat energy in the form of electromagnetic waves may be propagated in the absence of a medium. Conduction and convection rely on the medium for the movement of energy.*

Additional Questions:

1. What are some examples of radiant energy? *Sun, stovetop, electric space heater.*

Extensions:

1. Wrap the metal can with black or white pieces of construction paper. Compare the heat absorption.
2. Insulate the metal can with materials such as fiberglass, layers of newspaper, angel hair, or styrofoam. Compare the effectiveness of each insulating material.

Reading Comprehension Connections: I-3 (See page B-11.)

Resources:

Internet:
Concordia College, Moorhead, MN - Ask Dr. Physics
http://www.cord.edu/dept/physics/drphysics/
Doug Craigen's Home Page
http://www.cyberspc.mb.ca/~dcc/

Video:
Heat and Temperature. Films for the Humanities and Sciences. Order # ATE 4057.
Phase Changes. HRM Video. Order # NG-837-VSD.

Energy Transfer

(Student Handout)

Purpose: To examine the transfer of energy from one object to another including the energy transferred to the surroundings

Background:

Energy in the form of heat can be transferred in three ways: conduction, convection, and radiation. In the first two, there must be physical contact between the warm and cool object, or the heat must travel through some medium between the two. In radiation, however, the transfer occurs without contact between bodies, and no medium need be present.

Materials/Equipment:

Droplight with 60-watt bulb
Ruler
Ring stand
Clamp
Graduated cylinder
Thermometer
Small can or metal container
Timing device
Electrical outlet with Ground Fault Interrupt (GFI)

Safety Considerations: Follow all lab safety procedures. Caution should be used in connecting and using electrical devices. **Do not connect the droplight setup to the power source until the instructor has given approval.** Do not stare directly at the lighted bulb. Do not touch the lighted bulbs. Connect droplight only to an electrical outlet with GFI.

Procedure:

1. With graduated cylinder, measure 200 mL of water and pour into the metal can.
2. Attach the droplight to the ring stand so that the top of the metal can is exactly 10 cm below the light bulb.
3. Measure the temperature of the water and record it in the data table.
4. **Ask the teacher to check the setup. Upon approval from the teacher, connect the electrical power to outlet.** Leave the light on for exactly 10 minutes.
5. Again measure the temperature of the water and record it on the Data Table. Pour out the water from this trial.
6. Attach the droplight to the ring stand so that the top of the metal can is exactly 20 cm below the light bulb. Repeat Steps 1-5 with fresh water.
7. After measuring the change in temperature, calculate the amount of heat given off by the droplight, the amount of heat absorbed by the water, and the amount of heat "lost" to the "surroundings" (absorbed by the surroundings). Then compare the amount of heat given off by the bulb to the total heat absorbed by the water and surroundings.

(Remember energy change is calculated using ΔH = Mass x specific heat x ΔT, the density of water is 1g/mL, and the specific heat of water is 4.18 J/g-°C. Assuming the bulb is 100% efficient in converting electrical energy to light and heat, the energy released by the droplight is calculated using E = Power x time, where power is the bulb wattage and time represents seconds.)

Data Table:

Distance to Light (cm)	Water Volume (mL)	Initial Water Temperature (°C)	Final Water Temperature (°C)	Time (seconds)

Questions:

1. How is the distance between the light source and the water related to the amount of heat absorbed?
2. How much of the energy given off by the light was not absorbed by the water?
3. Where is the extra heat energy going?
4. Determine the source of electricity for the area (coal- or gas-powered steam generator, hydroelectric, or nuclear). Describe the energy transformations that occur from the potential energy of the source to the heat energy absorbed by the water.

Waves of Energy
(Teacher Notes)

Standard-Objective-Eligible Content: VII-2, a (See pages B-2 - B-10.)

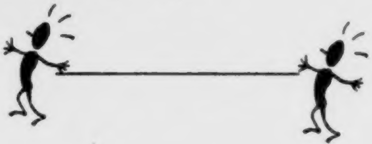
Lab Time: 50 minutes

Background: See student handout.

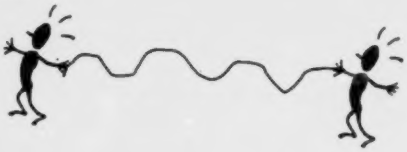
Materials:
Pre-Activity: rope (A cotton clothesline can be used for this demonstration.)
Activity: 2-meter rope sections (1 rope/2 students)
A copy of an electromagnetic spectrum table for each student.

Pre-activity:

1. Two students should demonstrate this activity.
2. Give each student one end of the rope.



3. One student should hold the rope still, while the other student shakes his end of the rope to create a wave pattern.



4. The class should observe the movement of the rope.
5. Ask the class to describe their observations.
6. Tell the student who is shaking the rope to shake the rope faster. Then tell the student to shake the rope slower. While the student is shaking the rope, point out the wave crests to the class. The student should stop shaking the rope.
7. Write the following terms on the board:
   Wavelength
   Frequency
   Energy
   Medium
8. Ask the class to describe how each term relates to the demonstration. Which is moving from one student to the other: the energy or the rope? What does the rope represent?
9. Ask the student who shook the rope if it took more energy to produce long wavelength waves (low frequency) or short wavelength waves (high frequency).

Activity:

Divide the class into student pairs. Give each pair a 2-meter piece of rope. Let the students conduct experiments by shaking the rope at different speeds to note how the movement affects the frequency and wavelength.

The students should write descriptive paragraphs comparing the spectrum of waves and the amount of energy associated with each type of radiation.

Student Question and Answer:

1. How does increasing energy affect the frequency and wavelength of the rope waves? *When energy increases, the frequency increases and the wavelength decreases.*

Extensions:

The students can check local news sources for information about different forms of radiation and their uses. (Examples: radio waves and space exploration; x-rays and medical research; electromagnetic waves and weather/climate forecasting).

Reading Comprehension Connection: I-3 (See page B-11.)

Resources:

Books:

Alridge, Bill, et al. *Science Interaction - Course 3.* Glencoe, 1995. pp. 82-84.
Maton, Anthea, et al. *Exploring Physical Science.* Prentice Hall, 1995. pp. 591-594.

Video/Multimedia:

Waves & Sound. Films for Humanities and Sciences. Order # ATE 6847.
The Nature of Waves. Films for Humanities and Sciences. Order # ATE 1201.

Internet:

Annenberg/CPB - Science & Math Initiatives and the Teacher Help Service
http://www.learner.org/sami/
Glenbrook South High School - Physics Tutorial
http://www.glenbrook.K12.il.us/gbssci/phys/class/waves/wavestoc.html
Ed Zona's - Physics and Mathematics
http://id.mind.net/~zona/mstm/physics/waves/waves.html

Waves of Energy

(Student Handout)

Purpose: To illustrate that short wavelength, high frequency waves carry more energy than long wavelength, low frequency waves

Background:

A wave is a traveling disturbance that carries energy from one place to another. Energy is the ability to do work or cause a change. Waves can be measured using wavelength and frequency. The highest points of waves are called crests. The lowest points of waves are called troughs. The distance from one crest to the next is called a wavelength. The number of complete wavelengths in a given unit of time is called frequency. As a wavelength increases in size, its frequency decreases. The speed of a wave can be determined by multiplying the wavelength by its frequency.

There are two basic types of waves: mechanical and electromagnetic. Mechanical waves (sound, ocean, seismic, or earthquake) must travel through a medium: a solid, liquid, or gas. Electromagnetic waves can travel through a medium or a vacuum. Electromagnetic waves are listed on a chart according to their wavelengths. Scientists call this chart the electromagnetic spectrum. Mechanical and electromagnetic waves with long wavelengths contain less energy than waves with short wavelengths.

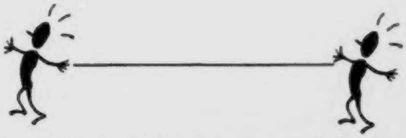
Materials: (groups of two)

2-meter rope

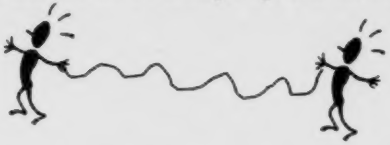
Safety Considerations: Always follow lab safety procedures.

Procedure:

1. The student and partner each take one end of the rope.
2. Hold the rope as shown.



3. One student should move the rope up and down to create a wave pattern along the rope.



4. Move the rope up and down the same distance for 30 seconds. Now double the distance and note the changes in the appearance of the rope. After 30 seconds, increase the distance again and note a pattern of change.

Question:

1. How does increasing energy affect the frequency and wavelength of the rope waves?

Use the information in the Electromagnetic Spectrum Table to compare and contrast the spectrum of waves and the amount of energy associated with each type of radiation.

Electromagnetic Spectrum Table

WAVES	FREQUENCY	WAVELENGTH	USES
Radio waves	Lowest Frequency (s^{-1})	Longest Wavelength (*n*m)	Radio, television, medicine (MRI), astronomy (radio telescopes)
Microwaves	↓	↓	Cooking, communications (cellular phones, radar)
Infrared Rays	↓	↓	Heat detection cameras for night vision pictures, security systems, military operations, heating materials
Visible Light	↓	↓	Essential for photosynthesis Visible light is the only part of the spectrum that can be seen with the unaided eye.
Ultraviolet Rays	↓	↓	Used to kill germs in hospitals Used in food processing to destroy bacteria High exposure can be harmful to plants and animals.
X-rays	↓	↓	Medical diagnosis Lifetime exposure can cause defects in cells.
Gamma Rays	Highest Frequency	Shortest Wavelength	Medical diagnosis Radioactive material may cause severe damage to living things.

Motion Madness

(Teacher Notes)

Standard-Objective-Eligible Content: VIII-1 (See pages B-2 - B-10.)

Lab Time: 50 minutes

Background: See student handout.

Materials: See student handout.
Teacher Demonstration: marble, clear pie-pan top, overhead projector, scissors, goggles
Remove a 5 cm. section from the side of the pie-pan top.
Activity 1: Use the file to smooth the edge of the clothes-hanger tips. This will help the students balance their pennies on the hangers.

Pre-Activity:
Write Newton's three laws of motion on the board. The teacher will demonstrate one of Newton's three laws of motion on the overhead projector. Place the pie pan-top on the projector. Place the marble in the pan and give it a push. The marble should revolve around the edge of the pan. When the marble reaches the cut-out section, it should exit the lid. The marble should move in a straight line. Ask the students to select the law that was demonstrated. They should select Newton's first law.

Activities:
Tell the students they are going to conduct two activities. Each activity will demonstrate Newton's first law of motion.

Activity 1:
Give the students a penny and a clothes hanger. The penny should be placed on the tip of the hanger. The students should twirl the hangers on their index fingers. This will create a centripetal force. The pennies should stay on the tip of the hangers in "orbit" around the students' fingers. The students should stop the hangers. The pennies will move in a straight line, thereby illustrating Newton's first law of motion.

Activity 2:
Divide the students into groups of four. Give each group an index card, several coins of different sizes, and a clear container (baby food jars or a clear plastic container). Tell the students to design a demonstration that will illustrate inertia, Newton's first law of motion.

Student Questions and Answers:

1. Relate Newton's first law of motion to the movement of the penny during the activity. *The spinning clothes hanger created a centripetal force that caused the penny to remain in orbit on the tip of the hanger. However, when the clothes hanger stopped spinning, the external force was removed. The removal of this force caused the penny to continue to move in a straight line tangent to the orbit.*

2. Based on this activity, how does Newton's law of motion (inertia) affect the movement of the moon around the Earth? *Newton's first law of motion states that an object in motion will stay in motion in a straight line unless acted upon by an external force. The Earth's gravity creates the force that causes the moon to stay in orbit around the Earth. If this force were removed, the moon would continue to move through space in a straight line.*

Extensions:

The students could analyze a space mission and list examples of how astronauts modify behaviors to account for consequences of Newton's three laws of motion in space.

Have cooperative groups discuss the following scenario:

> A train passes a station platform travelling at a speed of 150 km/h. A passenger looking outward through the train window jumps up in the air at the same time and to the same height as a person standing outside the train looking inward through the same window. Will the two people be looking at each other when they land? Explain how Newton's first law of motion affects both persons.

After reading the story, the students should relate the actions in the passage to Newton's first law of motion.

Reading Comprehension Connection: I-3, II-1, II-2, II-3, (See page B-11.)

Resources:

Books:

Bilash, II, Borislaw. *A Demo A Day.* Flinn Scientific, 1997. pp. 213, 216, 231.
Scott, John M. *Everyday Science Real-life Activities.* J. Weston Walch, pp. 1-13.

Internet:

Microsoft's Encarta Lesson Collection
http://www.encarta.msn.com/schoolhouse/lessons/
The Classroom Connect Resource Station
http://www.classroom.com/resource/
Concordia College, Moorhead, MN - Ask Dr. Physics
http://www.cord.edu/dept/physics/drphysics/

Video:

Inertia. Films for the Humanities and Sciences. Order #ATE1191.
Circular Motion. Films for the Humanities and Sciences. Order #ATE1188.

Motion Madness

(Student Handout)

Purpose: To demonstrate Newton's first law of motion and to relate the law to real-world applications

Background:

Inertia, Newton's first law of motion, states that an object will remain at rest or an object in motion will stay in motion at a constant velocity unless acted upon by an external force.

Materials:

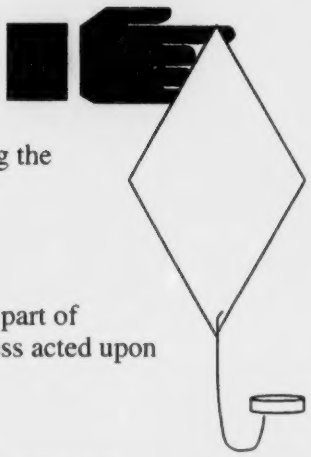
Activity 1: penny, clothes hanger, goggles (per student)
Activity 2: index card, glass jar, and coins of different sizes (per group)

Safety Considerations: Always follow lab safety rules. All students must wear goggles.

Procedure:

Activity 1

1. Put on safety goggles.
2. Place the bottom loop of the clothes hanger on your index finger.
3. Balance the penny on the filed end of the clothes hanger's tip.
4. Twirl the clothes hanger around your finger. The penny should remain on the tip of the hanger and "orbit" the finger. If the penny falls, try again. BE PATIENT!
5. Focus on the penny orbiting on the tip of the hanger. Stop twirling the hanger and observe the path of the moving penny.



Activity 2 (group)

1. Obtain the material needed for this activity from the teacher.
2. Use the materials to design a demonstration that will illustrate the part of Newton's first law that states an object at rest will stay at rest unless acted upon by an external force (inertia).

Observations:

Describe the movement of the penny during Step 4 and after Step 5 of Activity 1.

Questions:

1. Relate Newton's first law of motion to the movement of the penny during the activity.
2. Based on this activity, how does Newton's law of motion (inertia) affect the movement of the moon around the Earth?

Push-em-Back
(Teacher Notes)

Standard-Objective-Eligible Content: VIII-1; I-1, d (See pages B-2 - B-10.)

Lab Time: 1.5 to 2 hours

Background:
Accelerated motion can occur only when an unbalanced force is acting on an object. When the unbalanced force is applied, accelerated motion occurs; and when the force is balanced, the acceleration stops. The object often returns to a state of rest. Ask students to describe how everyday experiences support this description. Ask students to tell what force(s) are actually operating on the objects they describe. When they realize that friction causes the slowing of most moving objects, relate Newton's laws as a scientific description of motion. Sir Isaac Newton developed three basic laws of motion. The first law describes the property of matter called inertia. It states that a body at rest tends to remain at rest, and that a body in motion tends to remain in uniform motion along a straight line unless acted upon by some outside force. The second law deals with the effect of forces acting upon a body and the resulting acceleration. Newton's second law of motion states that the acceleration of a body varies directly with the amount of force exerted and inversely with the mass of the body. The third law states that for every action, there is an equal and opposite reaction of forces acting upon a body.

Materials: See student handout.

Pre-Activity:
Prior to the pre-activity, locate a level area in the school parking lot that allows for a clear travel distance of 20-30 meters. Ask students to observe an apple and a brick. Have students make predictions as to which object will fall to the ground the fastest. Ask them to justify their answers. Like Aristotle, they may think that the heavier an object is, the faster it will fall. This is a misconception based on intuition. Caution students about such intuitive misconceptions in the natural world. Ask them how Aristotle's belief could have been considered true by scholars for over 1,000 years without challenge? Have students understand that by using experimental evidence, a fundamental principle of modern science was ultimately responsible for the downfall of Aristotle's idea about falling objects. Have them research experiments performed by Galileo, Newton, and, in modern times, astronaut David Scott on the moon that questioned and disproved Aristotle's idea.

Activity:
Ask students if they have ever wondered how much force they exert when pushing an object such as a car. Pass out activity sheets and have students read them.

Place students into groups of six: a timer, a starter, and four pushers. (Number of pushers for the force test may vary.) Check to be certain that students can exert themselves for a period of time. (No medical hazards. Students who are unable to act as pushers are involved as timers and starters.) Be sure vehicle is washed before the activity. Have students measure a 20- to 30-meter course on a level area of the school parking lot or surrounding area. Try to use a smooth, firm surface to avoid slips or falls. To determine the force of friction, the teacher drives the vehicle into the course at about 3-5 Km/hr. When reaching the starting line, one of the starters indicates for timing to begin. The teacher shifts the car into neutral and lets it coast. Timing ends when the vehicle stops or leaves the course. The vehicle should be at or near stopping at the end of the course.

The student-force trials begin with the first group at the starting line. On the signal of the starter, they push the vehicle through the measured course (3-5 meters). The timer of that group records the time in the Data Table. The next group then completes a force trial, and other groups alternate until all groups have three runs. Students waiting are encouraged to cheer their competitors during the trial.

Post-Activity:

Upon returning to the classroom, the teacher should post the data of each group and show the students' sample calculations used in determining the force. The students should then calculate the amount of force that was exerted by their group and determine the average force per student. Students should discuss what the meaning of this calculation is and whether they think it has any real merit or not. They also will be asked to answer the questions. Discussion of these questions can be used to reinforce their knowledge of Newton's laws.

Sample Data and Calculations:

Vehicle Mass (kg)→	1650 kg		Friction Test Initial Velocity	3.0 km/hr
Friction Test	**Run #1**	**Run #2**	**Run #3**	**Average**
Time (seconds)	14.8 s	15.2 s	15.0 s	15.0 s
Distance (meters)	10.0m	10.0 m	10.0 m	10.0 m
Force Test	**Run #1**	**Run #2**	**Run #3**	**Average**
Time (seconds)	6.1 s	6.5 s	6.0 s	6.2 s
Distance (meters)	4.00 m	4.00 m	4.00 m	4.00 m

The average rate of deceleration (assuming a constant rate) is calculated using the equation $\mathbf{s = v_i t + \frac{1}{2}(a\,t^2)}$:

$$10.0\text{ m} = (3.0\text{ km/hr})(15.0\text{ s}) + \tfrac{1}{2}(a(15.0\text{ s})^2)$$
$$10.0\text{ m} = (3.0\text{ km/hr})(1000\text{ m/km})(1\text{ hr}/3600\text{ s})(15.0\text{ s}) + \tfrac{1}{2}(a(15.0\text{ s})^2)$$
$$10.0\text{ m} = 12.5\text{ m} + \tfrac{1}{2}(a(225.\text{ s}^2))$$
$$-2.5\text{ m} = \tfrac{1}{2}(a(225.\text{ s}^2))$$
$$-5.0\text{ m} = a(225.\text{ s}^2)$$
$$a = -5.0\text{ m}/225\text{ s}^2$$
$$a = -0.022\text{ m/s}^2$$

The friction force that decelerates the car is calculated using the equation **$f = ma$**. If the vehicle mass is 1650 kg,

$f = (1650 \text{ kg}) (-0.022 \text{ m/s}^2)$
$f = -36$ N (Remind students that $1 \text{ N} = 1 \text{ kg} \times 1 \text{ M/s}^2$.) This represents the friction force.

The acceleration is calculated (assuming constant acceleration) using the equation **$s = \frac{1}{2} (a t^2)$**:

$4.0 \text{ m} = \frac{1}{2} a(6.2 \text{ s})^2$
$8.0 \text{ m} = a(38. \text{ s}^2)$
$a = 8.0 \text{ m}/38. \text{ s}^2$
$a = 0.21 \text{ m/s}^2$

The net force exerted is **$f = ma$**. Vehicle mass is still 1650 kg.

$f = (1650 \text{ kg}) (0.21 \text{ m/s}^2)$
$f = 350$ N (Remind students that $1 \text{ N} = 1 \text{ kg} \times 1 \text{ M/sec}^2$.) This calculation represents the net force needed to move the car.

Therefore, the total force exerted by all four students to move the car is the sum of the net force calculated to accelerate the car and the friction force calculated above: 350 N + 36 N = 386 N. The average force each student exerts to move the car is determined when this force is divided by four.
386 N/4 = @ 96. N (Average force per student)

Student Questions and Answers:

1. What assumption must be made about the deceleration of the vehicle in the friction test? *The deceleration of the vehicle is assumed to be constant as a result of the friction force.*
2. What assumption must be made about the acceleration of the vehicle during the force test? *The acceleration of the vehicle must be constant for calculations to be valid.*
3. Why is the curb weight of the vehicle alone considered sufficient to use as the mass in determining the average force? *The mass is so large that slight variations due to driver or contents will cause little variation in the results of the calculations.*
4. Determine and diagram the forces exerted on the vehicle during the force trials. *Answers vary but should include friction force opposing the larger force of the students' accelerating the vehicle. The downward force of gravity is opposed by the upward force of the surface.*
5. Describe the effect on the measurements if a larger or smaller vehicle were used in the activity. *The time of the force trials should be greater (for large vehicle) or smaller (for small vehicle) depending on the change in mass; therefore, the acceleration also would increase (for smaller vehicle) or decrease (for larger vehicle).*
6. Newton's second law is used to calculate the pushing force. Describe how the other two laws are involved in the activity. *Newton's first law is seen in overcoming the static friction and inertia of the static vehicle in the initial push. Newton's third law is seen in each of the interacting forces on the vehicle (see extensions).*

Extensions:
The teacher may wish to ask the students to determine the effects of Newton's third law in each of the forces exerted in the push trials. For example, when the vehicle is pushed, it pushes back; or when their feet push against the pavement, the pavement pushes back. Also, the activity could be extended into work and power once the force is known and the distance and time are used. Other types of vehicles: carts, wheelbarrows, bicycles, or even wheel chairs can be used to determine the force of a pusher as long as the total mass can be determined.

Reading Comprehension Connections: I-3; II-3 (See page B-11.)

Resources:
Internet:
The Exploratorium - The Science of Hockey
http://www.exploratorium.edu/hockey/skating1.html
Concordia College, Moorhead, MN - Ask Dr. Physics
http://www.cord.edu/dept/physics/drphysics
Glenbrook South High School - Physics
Tutorialhttp://www.glenbrook.K12.il.us/gbssci/phys/class/newtlaws/newtltoc.html

Video/multimedia:
Acceleration. Films for the Humanities and Sciences. Order # ATE1192.
Energy and Force, Part I. Films for the Humanities and Sciences. Order # ATE4054.

Push-em-Back
(Student Handout)

Purpose: To utilize Newton's second law of motion in recognizing that the application of a force on a body produces acceleration and to calculate the average force that can be applied to a vehicle by the students

Background:
Sir Isaac Newton developed three basic laws of motion. The first law describes the property of matter called inertia and states that a body at rest tends to remain at rest and a body in motion tends to remain in uniform motion along a straight line unless acted upon by some outside force. Newton's second law of motion deals with the effect of forces acting upon a body and the resulting change in velocity. This second law of motion states that the acceleration of a body varies directly with the amount of force exerted and inversely with the mass of the body. The third law states that for every action there is an equal and opposite reaction of forces acting upon a body.

Materials/Equipment:
Car, truck, or van
Meter stick
Timing device

Safety Considerations: Teacher is driver at all times. To avoid slipping and injury, a smooth, firm surface should be chosen for the test course. Notify the teacher of any physical limitations. Use caution when pushing the vehicle.

Procedure:
1. Determine the mass of the vehicle. The mass can be found in the owner's manual as curb weight and then converted to kilograms.
2. Determine the mass of the driver.
3. Record the total mass of the car and driver in the Data Table.

Friction Test
1. The teacher drives the vehicle into the course at a slow speed (3-5 Km/hr).
2. When the starter signals that the vehicle is at the starting point, the teacher shifts the vehicle from drive to neutral. The timer begins timing as the vehicle coasts from the starting point through the course.
3. The timing ends when the vehicle stops or passes out of the measured course.
4. Measure the distance the car traveled.
5. Record the time and distance traveled by the vehicle on the Data Table.
6. Repeat Steps 4-8 two additional times and record data on the Data Table for Runs 2 and 3.

Force Test
1. The teacher returns the vehicle to the starting point of the measured course.
2. Beginning from rest, the vehicle is pushed through the course by Team 1 after the starter gives the signal.
3. The timer begins when the vehicle leaves the starting point and stops when the vehicle crosses the finishing line.

4. Record the distance and total time elapsed in the Data Table.
5. Repeat Steps 10-13 two additional times. The groups should alternate between trials to rest.
6. Calculate the average force exerted for each group.

Note: The acceleration of the vehicle is calculated by using the equation $s = at^2/2$, where **s** is the distance traveled, **a** is the acceleration, and **t** is the time of the trial. The force can then be calculated using $f = ma$ where **f** is the force, **m** is the mass, and **a** is the acceleration.

Data Table:

Vehicle Mass (kg)→			Friction Test Initial Velocity	
Friction Test	**Run #1**	**Run #2**	**Run #3**	**Average**
Time (seconds)				
Distance (meters)				
Force Test	**Run #1**	**Run #2**	**Run #3**	**Average**
Time (seconds)				
Distance (meters)				

Questions:

1. What assumption must be made about the deceleration of the vehicle in the friction test?
2. What assumption must be made about the acceleration of the vehicle during the force test?
3. Why is the curb weight of the vehicle alone considered sufficient to use as the mass in determining the average force?
4. Determine and diagram the forces exerted on the vehicle during the force trials.
5. Describe the effect on the measurements if a larger or smaller vehicle were used in the activity.
6. Newton's second law is used to calculate the pushing force. Describe how the other two laws are involved in the activity.

Fluid Pressure
(Teacher Notes)

Standard-Objective-Eligible Content: VIII-2, a (See pages B-2 - B-10.)

Lab Time: 25-30 minutes

Background:
Hydraulics is the branch of science that deals with water or other liquids at rest or in motion. Pascal's law is the basis of this science and essentially says that in a fluid at rest, pressure is the same in all directions and that a pressure applied to a confined liquid is transmitted equally in all directions. Pressure is the total force per unit area. The pressure exerted by a fluid is directly related to the depth and weight density of the fluid.

Materials/Equipment: See student handout.

Pre-Activity:
This activity can be used as an introduction to fluids and the engineering science of hydraulics or as a reinforcement of discussions on the topics. Allow the students time to read the activity sheet. Use the activity on "Cause and Effects of Pressure," page 27, in the document *Clarification and Expansion of Stanford 9 Science Objectives, Grades 9-11,* before doing this activity.

Activity:
The activity is simple, and students should be allowed to experiment and observe the fluid flow. They should be challenged to suggest procedures for quantifying all observations made. Measurement validity increases if one student continues to add water to the two liter bottle while another student measures the water stream distances. Care should be taken to see that play does not get too messy.

Post-Activity:
As a follow-up activity to get students to think about quantifying liquid pressures, try the activity on "Make a Prediction of Fluid Pressure," page 60, in the document *Clarification and Expansion of Stanford 9 Science Objectives, Grades 9-11.*

Student Questions and Answers:
1. What do you observe as the water flows freely from the holes? *Answers will vary, but students should observe that the distance water shoots from the holes increases with depth.*
2. What do you think causes the differences observed? *The greater the pressure, the greater the distance that water shoots out. They should infer that the greater the depth, the greater the pressure.*
3. How does the water flow differently with and without the cap if all other factors are the same? *Little water flows from the holes when the cap is on.*
4. Explain any differences observed. *Air cannot as easily flow in to take the place of the departing water when the top is capped.*
5. How do you account for what happens when you squeeze on the sides of the closed bottle? *The pressure on the sides of the bottle is distributed equally throughout the water inside the*

bottle. This equal pressure forces water out each hole causing each water stream to travel approximately the same distance.

6. Consider the plumbing system in a tall building as one large vertical container of water with branches. Explain why auxiliary pumps are sometimes necessary to maintain pressure in upper floors, while pressure regulators are necessary in the lower floors. *If the upper floors are above the water line of the water system (level to which water is forced up by some other force), the water has to be pumped to the higher floors and pressure maintained. Because of the tremendous downward force of the weight of that tall column of water, some pressure reduction may be needed through pressure regulators in the lower stories.*
7. The weight density of a certain fluid is $0.133\ N/dm^3$. What is the pressure on the bottom of a 5.05 dm deep container of the fluid? *Pressure on the surface equals weight density of the fluid times the depth of fluid.*
   $P = \underline{wd}\ x\ D$
   $P = 0.133\ N/dm^3\ x\ 5.05\ dm$
   $P = 0.672\ N/dm^2$

Additional Questions:

1. In Question 6 above, reference was made to the "water line." How does the height and/or location of a water tower influence this line (and subsequently the water pressure) for a city or town's water system?
2. How might the regulators work to relieve excess pressure in lower floors of a tall building?

Extensions: Connections can be made to biological systems as designated in VIII-2, b

Reading Comprehension Connections: I-3, II-2, II-3 (See page B-11.)

Resources:

Books:

Heimler, Charles H. *Principles of Science, Book I.* Charles E. Merrill Publishing Company, 1983. pp. 129-132.

Maton, Anthea, et al. *Motion, Forces, and Energy.* Prentice Hall, 1994. Pp. 60-69.

Booklet:

Clarification and Expansion of Stanford 9 Science Objectives, Grades 9-11. Montgomery, Alabama: Alabama State Department of Education, 1997. pp. 27, 60.

Internet:

University of Tennessee at Martin - Physical Science Activity Manual
http://cesme.utm.edu/resources/science/PSAM.html
Oregon Museum of Science and Industry - Science Learning Network - Water Works
http://www.omsi.edu/sln/ww/
NASA - Central Operation of Resources for Educators
http://spacelink.nasa.gov/CORE

Video/Multimedia:

Pressure. Bill Nye et. al. KCTS Television. 1994. Order # BN02-16 (Videotape).

Heart in Space: How Microgravity Affects the Cardiovascular System. Barbara Corbin, Executive Producer. Ames Research Center. 1997. Order # 400.0-80. (CD-ROM).

Fluid Pressure
(Student Handout)

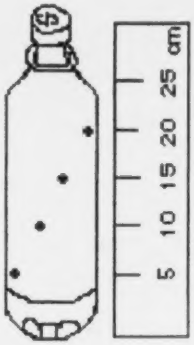
Purpose: To observe that the pressure exerted by a fluid is related to depth and to illustrate that external pressure is distributed equally throughout a liquid

Background:
Pressure is the force exerted per unit area. The pressure exerted by a fluid is directly related to the depth and weight density of the fluid. Pascal's Law also tells that an outside pressure applied to a confined liquid is equally distributed to all parts of the container.

Materials:
Plastic two-liter drink bottle with top
Food coloring
Thumb tack or push pin
Cookie pan
Large beaker
Tape
Ruler

Safety Considerations: Follow all lab safety procedures.

Procedure:



1. Remove the label from plastic bottle.
2. Using a thumb tack or push pin, place a diagonal line of three or four holes in the bottle at five-centimeter (5 cm) increments above the bottom rim. Holes should be diagonal (approximately 1 cm horizontally apart) so that the flow of one does not interfere with that from another (see diagram).
3. Place the ruler beside the holes and then place tape over each hole and the ruler.
4. Fill the bottle with colored water using the beaker.
5. When the bottle is full, place it with the holes facing the sink or a catch pan and remove the tape by pulling the ruler from the side of the bottle. Measure the distance that the water from each hole flows from the base of the bottle and record your observations. To keep water stream distances constant, one student should continue to add water to the two-liter bottle while another student measures the water stream distances.
6. Next return the tape to the holes and fill the bottle again.
7. Make sure the water is filled to the very top by allowing some to overflow into the sink. Place the cap tightly on the bottle.
8. Try to squeeze the bottle with constant pressure and measure the distance that water flows from each hole. Record these measurements. Pour out the water and clean any drops that may have spilled.

Data Table:

	Hole #1 (5cm)	**Hole #2 (10cm)**	**Hole #3 (15 cm)**	**Hole #4 (20 cm)**
Distance from base (cm)				
Distance from base when squeezed (cm)				

Questions:

1. What do you observe as the water flows freely from the holes?
2. What do you think causes the differences observed?
3. How does the water flow differently with and without the cap if all other factors are the same?
4. Explain any differences observed.
5. How do you account for what happens when you squeeze on the sides of the closed bottle?
6. Consider the plumbing system in a tall building as one large vertical container of water with branches. Explain why auxiliary pumps are sometimes necessary to maintain pressure in upper floors, while pressure regulators are necessary in the lower floors.
7. The weight density of a certain fluid is 0.133 N/dm^3. What is the pressure on the bottom of a 5.05 dm deep container of the fluid?

D. RESOURCES

SELECTED RESOURCES

Note: These resources are samples and do not necessarily carry the endorsement of the State Department of Education nor the AHSGE Task Force.

I. Books

Abraham, Michael, Donna Coshow, and William Fix. *ChemSource, Volume 3. "Periodicity."* ChemSource, Inc., (American Chemical Society at 1-800-209-04230). 1994.

Aldridge, Bill, et al. *Science Interaction - Course 3.* Glencoe, 1995.

Arms, Karen. *Environmental Sciences.* Holt, Rinehart and Winston, 1996.

Bendick, Jeanne. *Adaptations.* Franklin Watts, 1971.

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Legacy Inc., P.O. Box 3813, Montgomery, AL 36109, telephone (334) 270-5921. This organization has activities and information on all areas of environmental science.

E. ITEM SPECIFICATIONS: SCIENCE

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INTRODUCTION

This bulletin provides specific information about the *Alabama High School Graduation Exam,* Third Edition (AHSGE). Educators representing each state school board district as well as both city and county school systems served on the committees that determined the standards and objectives; determined the eligible content for the test; and reviewed, revised, and approved the actual items.

The standards and objectives for the AHSGE are also found in *Standards and Objectives* (*Reading Comprehension, Language, Mathematics, and Science*) *for the Alabama High School Graduation Exam,* Bulletin 1997, No. 16, and *Standards and Objectives* (*Social Studies*) *for the Alabama High School Graduation Exam,* Bulletin 1998, No. 13. The standards and objectives for science are specifically referenced in this document.

Teachers must be familiar with this document if they teach content that relates to the objectives measured on the graduation exam in the middle grades or in the high school grades. Further, teachers must use this document in focusing instruction for students who have demonstrated weaknesses on objectives measured on the pre-graduation examination and the AHSGE.

An item specification has a distinct purpose and provides essential information concerning the testing of an objective. Item specifications for science will follow this order:

STANDARD	Broad area of content to be assessed
OBJECTIVE	Specific skill within a standard to be assessed
ELIGIBLE CONTENT	Clarification and elaboration of an objective (where applicable)
SAMPLE ITEMS	Item formats to test each objective

The sample items in this bulletin will **not** be found on the pre-graduation examination or the AHSGE. The number of sample items in this bulletin does not necessarily reflect the weight of the content on the test. In order to identify the weight of the content, the following chart shows the number of items for each science objective.

OBJECTIVES		NUMBER OF ITEMS
I-1	Analyze the methods of science	7
II-1	Trace matter and energy transfer	8
II-2	Relate particle motion to matter states	4
II-3	Apply the periodic table	4
II-4	Identify physical and chemical changes	4
III-1	Distinguish among taxonomic groups	4
III-2	Differentiate characteristics of plants	8
III-3	Differentiate characteristics of animals	10
IV-1	Recognize genetic characteristics	4
IV-2	Define the function of DNA	6
V-1	Distinguish cell structures and functions	14
V-2	Differentiate between mitosis and meiosis	4
VI-1	Define the components of an ecosystem	7
VII-1	Relate energy conservation to transformation	4
VII-2	Relate waves to energy transfer	4
VIII-1	Apply Newton's three laws of motion	4
VIII-2	Relate force to pressure in fluids	4
TOTAL		100

The content of the science subject-area test is approximately 70% biology and 30% physical science.

Each test booklet contains a periodic table for use during the test. The periodic table from the test booklet must be returned to the Test Administrator after the student has completed the test. Therefore, a copy of the periodic table is included on the following page in this bulletin which can be duplicated as needed.

PERIODIC TABLE OF THE ELEMENTS

KEY:

Atomic Number
Name
Symbol
Atomic Mass

	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 Hydrogen **H** 1																	2 Helium **He** 4
2	3 Lithium **Li** 7	4 Beryllium **Be** 9											5 Boron **B** 11	6 Carbon **C** 12	7 Nitrogen **N** 14	8 Oxygen **O** 16	9 Fluorine **F** 19	10 Neon **Ne** 20
3	11 Sodium **Na** 23	12 Magnesium **Mg** 24											13 Aluminum **Al** 27	14 Silicon **Si** 28	15 Phosphorus **P** 31	16 Sulfur **S** 32	17 Chlorine **Cl** 35	18 Argon **Ar** 40
4	19 Potassium **K** 39	20 Calcium **Ca** 40	21 Scandium **Sc** 45	22 Titanium **Ti** 48	23 Vanadium **V** 51	24 Chromium **Cr** 52	25 Manganese **Mn** 55	26 Iron **Fe** 56	27 Cobalt **Co** 59	28 Nickel **Ni** 59	29 Copper **Cu** 64	30 Zinc **Zn** 65	31 Gallium **Ga** 70	32 Germanium **Ge** 73	33 Arsenic **As** 75	34 Selenium **Se** 79	35 Bromine **Br** 80	36 Krypton **Kr** 84
5	37 Rubidium **Rb** 85	38 Strontium **Sr** 88	39 Yttrium **Y** 89	40 Zirconium **Zr** 91	41 Niobium **Nb** 93	42 Molybdenum **Mo** 96	43 Technetium **Tc** (98)	44 Ruthenium **Ru** 101	45 Rhodium **Rh** 103	46 Palladium **Pd** 106	47 Silver **Ag** 108	48 Cadmium **Cd** 112	49 Indium **In** 115	50 Tin **Sn** 119	51 Antimony **Sb** 122	52 Tellurium **Te** 128	53 Iodine **I** 127	54 Xenon **Xe** 131
6	55 Cesium **Cs** 133	56 Barium **Ba** 137		72 Hafnium **Hf** 178	73 Tantalum **Ta** 181	74 Tungsten **W** 184	75 Rhenium **Re** 186	76 Osmium **Os** 190	77 Iridium **Ir** 192	78 Platinum **Pt** 195	79 Gold **Au** 197	80 Mercury **Hg** 201	81 Thallium **Tl** 204	82 Lead **Pb** 207	83 Bismuth **Bi** 209	84 Polonium **Po** 210	85 Astatine **At** 210	86 Radon **Rn** 222
7	87 Francium **Fr** 223	88 Radium **Ra** 226		104 Unnilquadium **Unq** 261	105 Unnilpentium **Unp** 262	106 Unnilhexium **Unh** 263	107 Unnilseptium **Uns** 262	108 Unniloctium **Uno** 265	109 Unnilennium **Une** 266									

6	57 Lanthanum **La** 139	58 Cerium **Ce** 140	59 Praseodymium **Pr** 141	60 Neodymium **Nd** 144	61 Promethium **Pm** (145)	62 Samarium **Sm** 150	63 Europium **Eu** 152	64 Gadolinium **Gd** 157	65 Terbium **Tb** 159	66 Dysprosium **Dy** 163	67 Holmium **Ho** 165	68 Erbium **Er** 167	69 Thulium **Tm** 169	70 Ytterbium **Yb** 173	71 Lutetium **Lu** 175
7	89 Actinium **Ac** 227	90 Thorium **Th** 232	91 Protactinium **Pa** 231	92 Uranium **U** 238	93 Neptunium **Np** 237	94 Plutonium **Pu** (244)	95 Americium **Am** (243)	96 Curium **Cm** (247)	97 Berkelium **Bk** (247)	98 Californium **Cf** (251)	99 Einsteinium **Es** (252)	100 Fermium **Fm** (257)	101 Mendelevium **Md** (258)	102 Nobelium **No** (259)	103 Lawrencium **Lr** (262)

ITEMS

BY

STANDARD AND OBJECTIVE

STANDARD I: The student will understand concepts dealing with the nature of science.

OBJECTIVE

1. Analyze the methods of science used to identify and solve problems.

ELIGIBLE CONTENT

- Use process skills to interpret data from graphs, tables, and charts.
- Identify and distinguish between controls and variables in a scientific investigation.
- Identify safe laboratory procedures when handling chemicals, using Bunsen burners, and using laboratory glassware.
- Identify and use appropriate Systeme International (SI) units for measuring dimensions, volume, and mass.
- Define and identify examples of hypotheses.
- Order the proper sequence of steps within the scientific process.
- Select appropriate laboratory glassware, balances, time measuring equipment, and optical instruments to conduct an investigation.

SAMPLE ITEMS

1 The tools that would help you determine whether one liquid is more dense than another are

A Bunsen burner and scale balance

B metric ruler and graduated cylinder

* **C** graduated cylinder and scale balance

D mercury thermometer and Bunsen burner

2 The unit of measurement you should use to measure the amount of liquid in a glass is

A grams

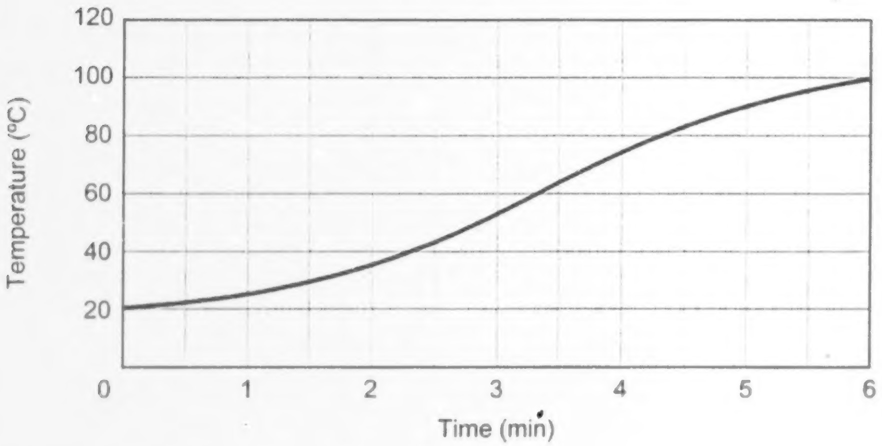
B kilograms

* **C** milliliters

D centimeters

3 Study the graph below.

TIME vs. TEMPERATURE OF HEATED WATER



One liter of water was heated and its temperature was recorded every minute for six minutes. The results are shown on the graph. According to the graph, between the second and fourth minutes, the temperature rose

A 20°

* **B** 40°

C 60°

D 80°

4 These are four of the steps in sequence for conducting a controlled experiment:

Step 1: Develop an experiment hypothesis.

Step 2: Develop an experiment plan.

Step 3: Set up the experiment materials.

Step 4: Record the experiment data.

At what point in the sequence should a controlling variable be selected?

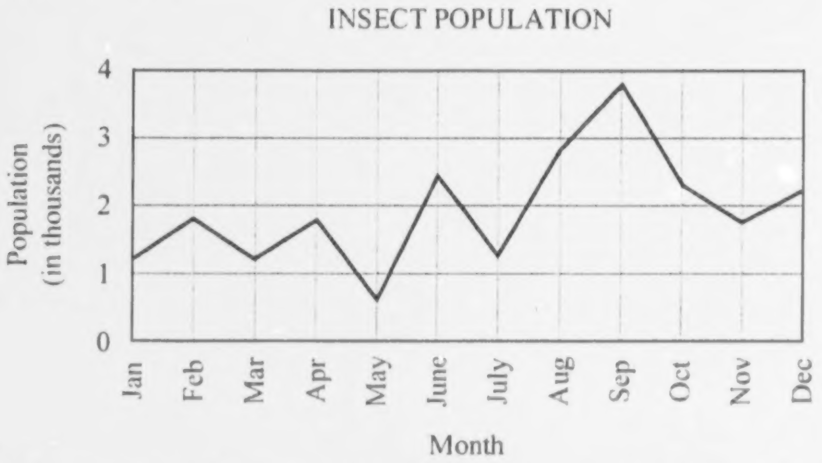
A during Step 1

* **B** during Step 2

C between Steps 1 and 2

D between Steps 3 and 4

5 Study the graph below.



The graph shows the seasonal change in the population of a certain species of insect. During which month did the population reach its peak?

A June

B July

C August

* **D** September

6 A controlled experiment is set up in duplicate. A single factor is changed in one setup but no change is made in the other setup. The factor to which NO change was made is known as the

* **A** control

B variable

C hypothesis

D observation

7 Read the paragraph and study the chart below.

Edward conducted an experiment to determine the concentration of fertilizer that will make his pea plants grow tallest. First he planted one pea in each of four identical pots. He then placed all four pots in the same room and made sure they all received the same amount of sunlight. He watered the pea plants twice a week for three months.

Plant	Amount of Fertilizer in Water
1	25ml of water with 0mg fertilizer
2	25ml of water with 5mg fertilizer
3	25ml of water with 10mg fertilizer
4	25ml of water with 20mg fertilizer

The chart shows how much water and fertilizer he gave to each plant. What is the independent variable?

A rate of growth of the pea plants

* B concentration of fertilizer in water

C number of peas the plants produced

D amount of sunlight the plants received

8 Two similar species of rodents live in the same forest. A biologist observes that one rodent population is much larger than the other. The biologist believes that the difference is due to better protective coloration in the larger population. A research project is set up to test this idea.

The biologist's idea that the population numbers are influenced by coloration is called

A a fact

B an observation

* C the hypothesis

D the conclusion

9 A biologist believes that a certain chemical causes rapid growth in plants. Several plants will be divided into either an experimental group or a control group to test this hypothesis. Which of these is the BEST way for the biologist to design the experiment?

A One group should be given the chemical at full strength; the other group should be given the chemical in water.

* **B** One group should be given water containing the chemical; the other group should be given water without the chemical.

C One group should be given the chemical every day; the other group should be given the chemical every other day.

D One group should be given the chemical at nighttime; the other group should be given the chemical during the daytime.

10 A science student is asked to prepare a wet-mount slide for an experiment. Which of the following instruments should the student use with the wet-mount slide?

A Bunsen burner

B test tube clamp

C Erlenmeyer flask

* D compound microscope

11 Which of these MOST likely has a volume of about 60 cm^3?

A backpack

B television

C biology textbook

* D pocket calculator

12 Which of these is NOT a step that should be taken after finishing a laboratory activity?

A returning all materials to their proper places

* B returning unused chemicals to their original bottles

C cleaning the laboratory table and equipment thoroughly

D disposing of unused chemicals as instructed by the teacher

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

1. Trace the transfer of matter and energy through biological systems.

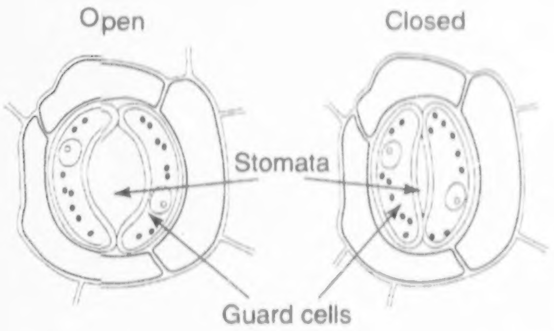
ELIGIBLE CONTENT

- Identify, define, and distinguish among producers (autotrophs), consumers, and decomposers (heterotrophs).
- Trace the flow of energy through food chains, food webs, and energy pyramids.
- Identify the reactants and products associated with photosynthesis and cellular respiration and the purpose of these two processes.
- Describe the carbon, nitrogen, and water cycles—including transpiration and respiration.

SAMPLE ITEMS

1 Read the paragraph and study the pictures below.

Plants lose water vapor to the environment through pores in their leaves. These pores are known as *stomata*. The stomata are surrounded by guard cells that regulate the size of these openings in the leaf.



On a very hot, dry day, the guard cells would most likely

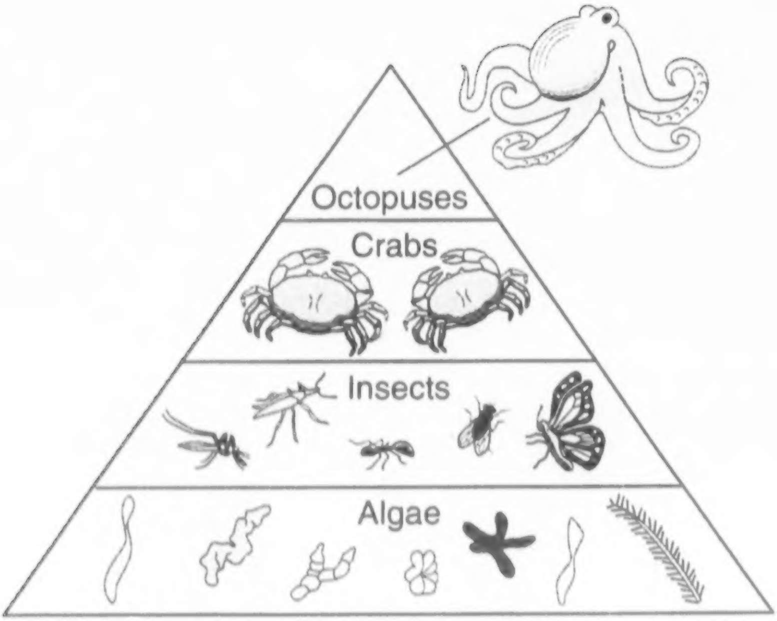
A divide and produce more guard cells

* **B** relax and cause the stomata to close

C fill up and transport water into the plant

D shrink and allow more water to escape

2 Study the pyramid below.


Octopuses
Crabs
Insects
Algae

The pyramid represents the flow of energy through the organisms in an ecosystem.

According to this pyramid, which group of organisms has the LEAST available energy?

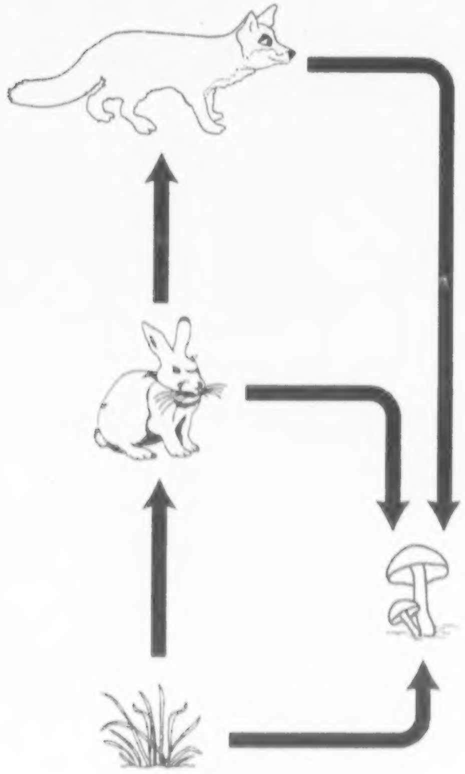
A algae

B crabs

C insects

* **D** octopuses

3 Study the food web below.



Which of these organisms is a primary consumer?

A fox

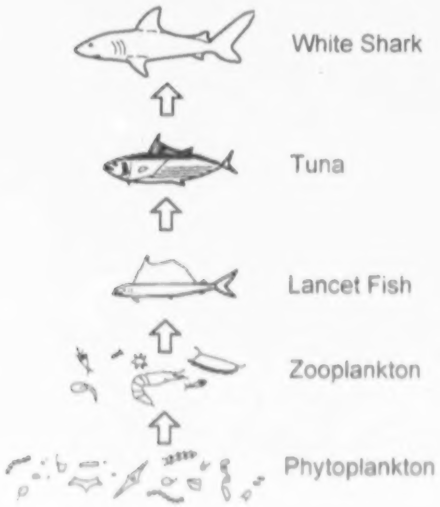
B grass

* **C** rabbit

D mushroom

- 191

4 Study the diagram below.


White Shark
Tuna
Lancet Fish
Zooplankton
Phytoplankton

The tuna could be classified as a

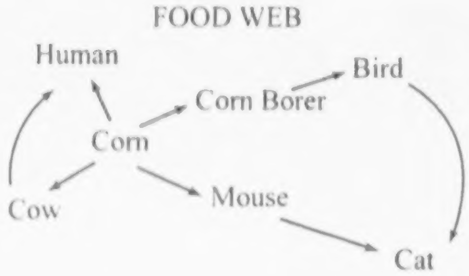
* A tertiary consumer

B secondary consumer

C primary consumer

D quaternary consumer

5 Study the diagram below.


FOOD WEB
Human
Bird
Corn Borer
Corn
Cow
Mouse
Cat

How many primary (first-order) consumers does the food web include?

A one

B two

C three

* D four

6 Which of these statements describes these four organisms: bird, mushroom, cow, and grasshopper?

A They are all autotrophs.

* B They are all heterotrophs.

C Some are autotrophs and some are heterotrophs.

D Some are autotrophs and some are decomposers.

7 The amount of available energy in a food pyramid decreases from

A heterotrophs to autotrophs

B decomposers to carnivores

* C producers to tertiary consumers

D primary consumers to herbivores

8 What is a plant's role in the carbon cycle during photosynthesis?

A It allows carbon to go back into the atmosphere.

* **B** It produces organic carbon compounds called carbohydrates.

C It makes carbon dioxide by combining oxygen with carbohydrates.

D It produces inorganic carbon compounds that are released during decomposition.

9 A type of cell structure found ONLY in producers is

A cytoplasm

* **B** chloroplast

C mitochondrion

D plasma membrane

10 Which of the following uses glucose ($C_6H_{12}O_6$) and oxygen (O_2) to produce energy, carbon dioxide (CO_2), and water (H_2O)?

A fermentation

* **B** respiration

C transpiration

D photosynthesis

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

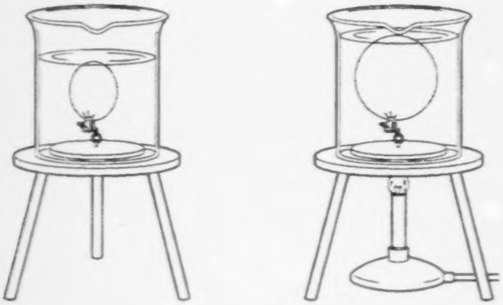
2. Relate particle motion to the states of matter (solids, liquids, and gases).

ELIGIBLE CONTENT

- Identify states of matter in terms of molecular (particle) movement, density, and kinetic energy associated with each phase/state of a given type of matter.

SAMPLE ITEMS

1 Study the pictures below.



These pictures show how a balloon that is submerged in water changes as the water is heated.

Which property of the air inside the balloon decreases as the water is heated?

A mass

B volume

* **C** density

D temperature

2 One difference between a kilogram of solid steel and a kilogram of liquid steel is that the kilogram of solid steel

A weighs more

* **B** takes up less space

C takes up more space

D has more kinetic energy

3 Atoms in a gaseous state have

A less weight than the same atoms in a liquid state

B less volume than the same atoms in a liquid state

* **C** more energy than the same atoms in a liquid state

D stronger atomic bonds than the same atoms in a liquid state

4 At the instant a liquid reaches its boiling point and changes into a vapor, which of these remains the same in both physical states?

A density

* **B** temperature

C volume

D kinetic energy

5 Which of the following describes the molecules of a liquid when compared to a gas?

A They are far apart and easily compressible.

B They are far apart and almost incompressible.

C They are close together and easily compressible.

* **D** They are close together and almost incompressible.

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

3. Apply information from the periodic table and make predictions using the organization of the periodic table.

ELIGIBLE CONTENT

- Determine the number of protons, neutrons, electrons, and mass of an element using the periodic table.
- Use the periodic table to identify and locate metals, nonmetals, metalloids, and noble gases.
- Use data about the number of electrons in the outer electron shell of an atom, including simple dot diagrams, to determine its stability/reactivity and be able to predict ionic charge resulting from reactions.

SAMPLE ITEMS

Use the periodic table on page 3 to answer Numbers 1 through 6.

1 When Na (sodium) reacts with Cl (chlorine), NaCl (sodium chloride) results. To form NaCl, what ionic charge must Na have?

A Na^{2-}

B Na^{1-}

* **C** Na^{1+}

D Na^{2+}

2 According to the periodic table, an example of a nonmetal is

A lithium (Li)

* **B** chlorine (Cl)

C tantalum (Ta)

D mercury (Hg)

3 Which of these electron dot diagrams represents an atom of carbon?

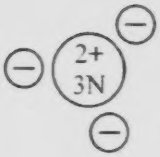
A $\dot{\mathrm{C}}$

B $\cdot\dot{\mathrm{C}}\cdot$

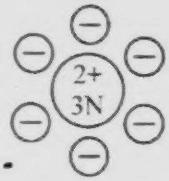
* **C** $\cdot\underset{\cdot}{\dot{\mathrm{C}}}\cdot$

D $\cdot\underset{\cdot}{\ddot{\mathrm{C}}}\cdot$

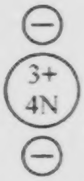
4 Which of the following represents a typical neutral atom?



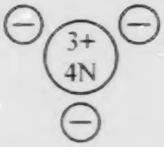
A



B



C



* **D**

Key:
+ = proton
− = electron
N = neutron

5 Which of these characteristics must be the same for all atoms of the same element?

* **A** number of protons

B number of protons and neutrons

C number of electrons and neutrons

D number of neutrons

6 The number of neutrons that are normally present in an atom of oxygen is

A 4

* **B** 8

C 16

D 24

7 Isotopes are atoms of the same element that differ in mass because they have the same number of

A neutrons but different number of protons

B electrons but different number of protons

C protons but different number of electrons

* **D** protons but different number of neutrons

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

4. Identify how factors affect rates of physical and chemical changes.

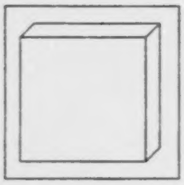
ELIGIBLE CONTENT

- Demonstrate knowledge that some factors and substances can affect the rate at which physical and chemical changes occur in living and nonliving systems—such as the digestive process.

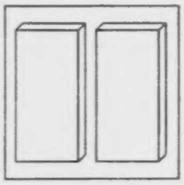
Note: Factors and substances include such things as temperature, concentration, surface area, and catalysts—including enzymes.

SAMPLE ITEMS

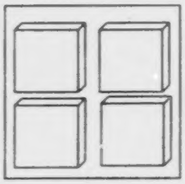
1 Which of the following pieces of ice, produced with equal volumes of water, would melt the slowest at the same room temperature?



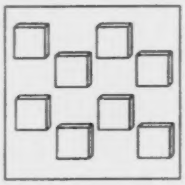
*A



B



C



D

2 Scientists discovered in the 1950s that plastics could be manufactured faster and at lower temperatures by adding special metal compounds to the petroleum mixture. This special metal compound is an example of a

* **A** catalyst

B solvent

C solute

D polymer

3 One important role of an enzyme in cell activities is to

A keep the acidity of the cell constant

* B lower the energy required to begin a reaction

C provide the energy for producing chemical bonds

D raise the temperature of the cell so molecules will react

4 An enzyme is present in a solution undergoing a reaction. The reaction occurs faster as the solution is heated. As the temperature of the solution continues to rise, the rate of the reaction levels off and then begins to decrease.

Why does this occur?

A The reaction has reached a state of equilibrium.

B The enzyme has begun to bind with the reactants.

C The solution has become saturated with the enzyme.

* D The extreme heat makes the enzyme lose its ability to function.

5 Which of these describes the reaction rate when a chemical mixture is heated?

A Kinetic energy increases and the reaction rate decreases.

B Kinetic energy decreases and the reaction rate decreases.

C Kinetic energy decreases and the reaction rate increases.

* D Kinetic energy increases and the reaction rate increases.

6 Which of the following will increase the rate of a chemical reaction?

A decreasing the pressure

B decreasing the surface area

C increasing the volume

* D increasing the temperature

7 Which of these will NOT speed up the rate at which sugar dissolves in water?

* A adding more sugar

B stirring the mixture

C increasing the temperature

D increasing the amount of water

STANDARD III: The student will understand concepts of the diversity of life.

OBJECTIVE

1. Distinguish among the taxonomic groups by major characteristics.

ELIGIBLE CONTENT

- Recognize the correct sequence or taxonomic classification of organisms from the most inclusive level to the least inclusive level—may include use of a chart to compare two species and to identify the classification level at which one species no longer shares common characteristics with other species.
- Classify organisms into the five kingdoms based on recognizing two or more characteristics associated with organisms in a given kingdom.
- Recognize properly written scientific names using binomial nomenclature.

SAMPLE ITEMS

1 Which characteristic most clearly differentiates plants from fungi?

A cell wall

B presence of a nucleus

C multicellular structure

* **D** ability to carry out photosynthesis

2 Related phyla are grouped into a

A class

B genus

C family

* **D** kingdom

3 Study the taxonomic chart below.

	Human	Dog
Kingdom	Animalia	Animalia
Phylum	Chordata	Chordata
Class	Mammalia	Mammalia
Order	Primates	Carnivora
Family	Hominidae	Canidae
Genus	Homo	Canis
Species	sapiens	familiaris

What is the LOWEST taxonomic level at which the dog and human share common characteristics?

* **A** class

B order

C family

D phylum

4 Insects, arachnids, millipedes, centipedes, and crustaceans are grouped together in the phylum Arthropoda because

A they all lack backbones and compound wings

* **B** they all have jointed legs

C they all reproduce sexually and give birth to live young

D they all have more than two legs

5 All of the following statements about the scientific name for an organism are true EXCEPT

A the genus name is listed first

* **B** the species name is listed first

C the genus name begins with a capital letter

D the species name does not begin with a capital letter

6 Which of these is the LEAST inclusive taxonomic group?

A genus

B family

* **C** species

D kingdom

STANDARD III: The student will understand concepts of the diversity of life.

OBJECTIVE

2. Differentiate structures, functions, and characteristics of plants.

ELIGIBLE CONTENT

- Identify various plants as being vascular or nonvascular and describe the basic mechanisms by which vascular and nonvascular plants sustain themselves.
- Identify the distinguishing characteristics of angiosperms and gymnosperms in terms of their structures and reproduction.
- Identify reproductive structures and their functions in angiosperms.
- Demonstrate knowledge of which characteristics/traits would be best suited for plants growing in different environments and/or exposed to different pests.

SAMPLE ITEMS

1 For which type of habitat are plants with very large, flat leaves best suited?

A cold, dry, and shady

B warm, dry, and sunny

C cold, humid, and sunny

* **D** warm, humid, and shady

2 Which of the following is NOT directly involved in the reproduction of angiosperms?

A style

B pistil

C anther

* **D** sepal

3 In which type of habitat are prop roots (roots half in soil and half in air) an important adaptation?

A desert

* **B** swamp

C alpine

D grassland

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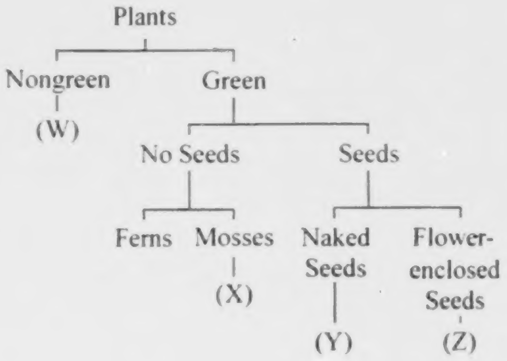
4 Study the chart below.

Plant Parts	Plant 1	Plant 2	Plant 3
Flowers	X		
Seeds	X		X
Spores		X	
Roots	X	X	X
Leaves	X	X	X
Water transport tubes	X	X	X

This chart shows the characteristics of three different plants. Plant 3 on the chart could be a

A moss
B fungus
* **C** pine tree
D fruit tree

5 Study the diagram below.


Plants
Nongreen
Green
(W)
No Seeds
Seeds
Ferns
Mosses
Naked Seeds
Flower-enclosed Seeds
(X)
(Y)
(Z)

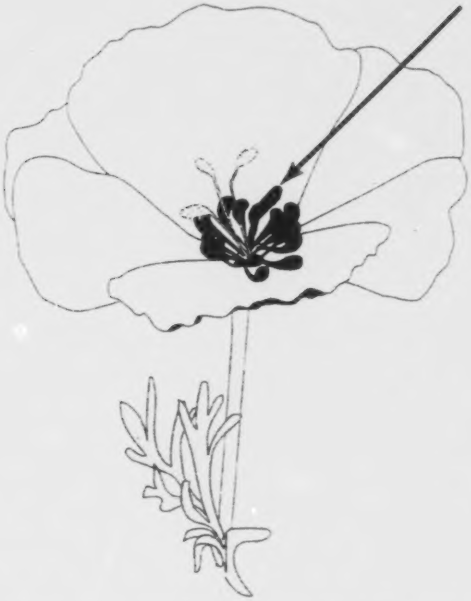
In the diagram, a pine tree should be placed at which of the following positions?

A (W)
B (X)
* **C** (Y)
D (Z)

6 All of these are part of the female reproductive organ in angiosperms EXCEPT the

A style
B ovary
* **C** anther
D stigma

7 Study the drawing below.



The pollen-producing structure indicated by the arrow is the

A style

B pistil

* **C** anther

D sepal

8 Mosses rarely grow more than a few inches high and tend to occupy moist habitats on or near the ground. This is because mosses do not have

A a method for pollination far from the ground

B a method to spread their spores far from the ground

C chlorophyll, so they need to be near a source of decaying organic matter

* **D** a vascular system to allow transport of water and nutrients to upper branches

9 Mosses lack rigid supporting tissue and are most common in damp habitats. Mosses are classified as

A angiosperms

B gymnosperms

C vascular plants

* **D** nonvascular plants

10 Many plants have pores in their leaves through which they exchange gases with the environment. These pores are called *stomata*. Some plants have their stomata buried deep in their leaves to protect the plant from excessive transpiration.

The environment in which plants with this adaptation would most likely be found is a

A taiga

* **B** desert

C marsh

D rain forest

11 Dutch elm disease is caused by a parasitic fungus. The fungus invades the water-conducting vessels of a tree. In response, the tree produces gums and resins that clog its own transport system and cause the tree to die. The dead tree becomes a breeding site for elm-bark beetles. The beetles then carry the parasite to a nearby tree, and the process starts again.

What is the cause of tree death in Dutch elm disease?

A root rot

B leaf destruction

C decreased growth

* **D** inadequate water flow

STANDARD III: The student will understand concepts of the diversity of life.

OBJECTIVE

3 Differentiate structures, functions, and characteristics of animals.

ELIGIBLE CONTENT

- Distinguish characteristics of vertebrates and invertebrates in terms of a broad but basic range of physical and reproductive traits.
- Explain how animals are adapted to their environment—such as protective coloration, mimicry, claws, beaks, etc.

SAMPLE ITEMS

1 Each of these can occur in the reproductive processes among mammals, EXCEPT

A laying of eggs

* **B** stages of metamorphosis

C embryonic development in uterus

D continued development in mother's pouch

2 The ladybug's red color and black dots keep birds and other predators away. This adaptation is an example of

A cryptic coloration

B adaptive radiation

C aggressive mimicry

* **D** warning coloration

3 Which of these processes enables insects to eat different types of food and thrive in different environments at different life stages?

A molting

B meiosis

C mutation

* **D** metamorphosis

4 Which of these animals would be LEAST affected by extremely high daytime temperatures in a desert environment?

A a bird with large white feathers

* **B** a mammal that burrows underground

C an amphibian with smooth, moist skin

D a reptile that must move from place to place

5 Which of these BEST explains why a rattlesnake's heart is more efficient than a lobster's heart?

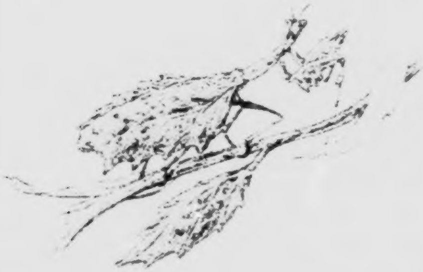
A The lobster's complex segmented body makes it more difficult for the heart to pump blood.

B The rattlesnake's warmer environment provides more energy for its heart to circulate blood.

* **C** Unlike the lobster, the rattlesnake's heart is able to separate oxygen-rich and oxygen-poor blood during circulation.

D Unlike the rattlesnake, the lobster's exoskeleton makes it harder for it to pump blood because of increased body pressure.

6 Study the picture of the praying mantis with broad, leaf-like wings.



Which of these is this an example of?

* **A** protective resemblance

B symbiosis

C metamorphosis

D warning coloration

7 At great ocean depths, it is very dark because most of the sunlight has been absorbed. Some animals have special adaptations such as *bioluminescence*, which enables the animals to produce their own light. The midwater jellyfish has bioluminescence in its tentacles. If disturbed, the bioluminescent tentacles break off and the jellyfish swims rapidly away in darkness.

The midwater jellyfish probably loses its bioluminescent tentacles to

A attract prey

B attract mates

* **C** distract predators

D camouflage itself

8 Although it lays eggs closely resembling those of reptiles, the *echidna*, or spiny anteater, is considered a mammal. Which two characteristics have scientists used to justify classifying it as a mammal and not as a reptile?

* **A** It possesses hair and produces milk for its young.

B It has an internal skeleton and breathes through lungs.

C It has a central nervous system and reproduces sexually.

D It possesses a highly developed sense of smell and hunts for its food.

STANDARD IV: The student will understand concepts of heredity.

OBJECTIVE

1. Recognize heritable characteristics of organisms.

ELIGIBLE CONTENT

- Identify physical traits that are passed from parents to offspring.
- Recognize how genetic traits including diseases and disorders are passed from one generation to the next—may include family pedigrees and monohybrid Punnett squares.
- Identify what happens to the DNA code when a mutation occurs and identify the major causes of mutations.
- Recognize and evaluate the harms and benefits that result when mutations occur.

SAMPLE ITEMS

1 Study the Punnett square below.

Male

Female	**WW**	**Ww**
	Ww	**ww**

W = dominant
w = recessive

Two hamsters with white fur produced an offspring with brown fur. If "W" represents the gene for white fur and "w" represents the gene for brown fur, which of these combinations of parents will yield offspring with brown fur (ww)?

A WW and ww

B WW and Ww

* **C** Ww and Ww

D WW and WW

2 A mutation may be passed along to human offspring

A through the process of mitosis only

* **B** through the process of meiosis only

C by the process of either mitosis or meiosis

D by a process other than mitosis or meiosis

3 What is the minimum number of point mutations that can cause DNA to code for a different amino acid?

* **A** one

B two

C three

D four

4 Compared to a small leaf, a large leaf size increases the surface area needed for capturing sunlight for photosynthesis but also increases evaporative water loss. A series of mutations that eventually results in narrow, needle-like leaves would MOST often be

A harmful in both desert and tropical areas

B beneficial in both desert and tropical areas

* **C** beneficial in desert areas but harmful in tropical areas

D harmful in desert areas but beneficial in tropical areas

5 A very low rate of mutation in a population will probably be

A harmful to the population in both rapidly changing and stable environments

B beneficial to the population in both rapidly changing and stable environments

C beneficial to the population in a rapidly changing environment but harmful in a stable environment

* **D** harmful to the population in a rapidly changing environment but beneficial in a stable environment

6 In one year, a small town experienced a flood, several tornadoes, a chemical spill into the river, and an outbreak of food poisoning from tainted milk. The next year, several newborn calves were found to have serious birth defects.

Of the disasters from the previous year, which is the MOST likely to have contributed to the birth defects?

A flood

B tornadoes

* **C** chemical spill

D food poisoning

7 Chromosomes are made up of many genes. These genes consist of a specific sequence of bases. Which of these statements correctly describes what ALWAYS happens to the DNA code when a mutation occurs?

* **A** The base sequence within a given gene is changed.

B A portion of a chromosome is repeated.

C A gene is removed from a chromosome.

D A dominant allele is changed to a recessive allele.

8 Study the Punnett square below.

Male

		T	**t**
Female	**T**	**TT**	**Tt**
	t	**Tt**	**tt**

T = dominant
t = recessive

The gene for tallness (T) is dominant. What heights will the offspring of two pea plants have?

A 25% will be tall, 75% will be short

* **B** 75% will be tall, 25% will be short

C 50% will be tall, 50% will be short

D 25% will be tall, 50% will be medium, and 25% will be short

9 A mutation results in a condition known as albinism, in which animals have pink eyes and white fur and skin. Which of these BEST explains why a mouse with albinism would be at a disadvantage for survival in the wild?

A White fur is difficult to keep clean.

B White fur dries much more slowly than dark fur.

C White fur does not retain heat as well as dark fur.

* **D** White fur makes it difficult to hide from predators.

10 Study the Punnett square below.

Father

		B	**b**
Mother	**B**	**BB**	**Bb**
	b	**Bb**	**bb**

B = dominant
b = recessive

If "B" represents offspring with brown eyes, and "b" represents offspring with blue eyes, how many brown-eyed and how many blue-eyed offspring can be expected with four children?

A 2 brown-eyed, 2 blue-eyed

B 1 brown-eyed, 3 blue-eyed

* **C** 3 brown-eyed, 1 blue-eyed

D 4 brown-eyed, 0 blue-eyed

STANDARD IV: The student will understand concepts of heredity.

OBJECTIVE

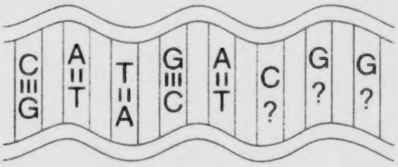
2. Explain how the DNA molecule transfers genetic information from parent to offspring.

ELIGIBLE CONTENT

- Describe the relationships among DNA, genes, and chromosomes.
- Describe in basic terms the structure and function of DNA.
- Define the genetic purpose for meiosis from generation to generation.
- Define and distinguish between dominant and recessive genes and how each is expressed in parents and offspring.

SAMPLE ITEMS

1 Study the picture below.



This drawing shows a segment of DNA with the four bases adenine (A), thymine (T), guanine (G), and cytosine (C). What is the correct order for the three bases represented by question marks?

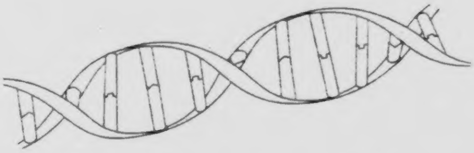
A ATT

B CAG

* **C** GCC

D ACA

2 Study the picture below.



This picture most likely represents

* **A** DNA

B RNA

C ATP

D NAD

3 The long, thin, string-like molecules located primarily in the nucleus of eukaryotic cells are known as

* **A** DNA

B RNA

C genes

D chromosomes

4 The process of meiosis

* **A** enables each parent to contribute genes to the offspring

B reduces the total number of chromosomes present in the offspring

C increases the chance of beneficial mutations being passed to the offspring

D prevents harmful mutations in the parents from being passed to the offspring

5 Which of these describes a recessive gene trait?

A one that causes a mutation

* **B** one that can be masked by a dominant gene trait

C one that can appear only if it is heterozygous

D one that will not express itself if it is homozygous

6 In what percentage of heterozygous individuals will a dominant allele be expressed?

A 0%

B 25%

C 50%

* **D** 100%

7 Each chromosome is composed of which of the following?

A one very long gene molecule

B thousands of protein molecules

* **C** one very long DNA molecule

D thousands of RNA molecules

8 A student is studying the genetics of fruit flies. She crosses two fruit flies that have red eyes and discovers that 7 out of 28 offspring have white eyes. What is the most likely conclusion she reached?

A Only one of the parents must have had an allele for the white-eyed trait.

* **B** The white eye trait is recessive and that both parents must have been heterozygous for this trait.

C The white eye trait is a new dominant trait that will eventually replace the red eye trait.

D The white-eyed offspring resulted from careless procedures used during the experiment.

9 Which of these is an active region of DNA?

A a cell

* **B** a gene

C a gamete

D a chromosome

10 Variation is important to the survival of any species. Which of the following processes BEST ensures variation from generation to generation?

* **A** meiosis

B mitosis

C cellular replication

D cellular respiration

STANDARD V: The student will understand concepts of cells.

OBJECTIVE

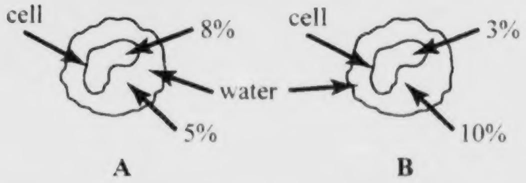
1. Distinguish relationships among cell structures, functions, and organization in living organisms.

ELIGIBLE CONTENT

- Define and identify representations of diffusion and osmotic systems and what substances are transported by these processes—may include graphic representations.
- Recognize differences between active and passive transport of substances and the energy requirements associated with these transport systems.
- Identify and define similarities and differences between plant and animal cells.
- Classify organisms as prokaryotic or eukaryotic; identify and define similarities and differences between prokaryotic and eukaryotic cells.
- Describe cell locomotion by means of cilia and flagella and recognize some organisms that depend on one or the other of these means of locomotion.
- Identify cell organelles and define functions of cell organelles—may include graphic representations.
- Distinguish and identify examples of cellular organization at the cell, tissue, organ, system, and organism level.

SAMPLE ITEMS

1 The percentages in these diagrams show the concentration of salt in two cells and in the water around each cell.



What will happen in cell A and cell B?

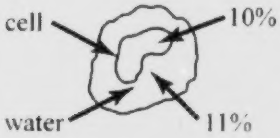
A Water will leave cell A and water will enter cell B.

* **B** Water will enter cell A and water will leave cell B.

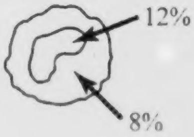
C Water will leave both cells A and B.

D Water will leave cell A but will remain unchanged in cell B.

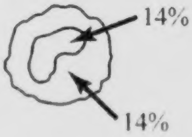
2 The percentages in these diagrams show the concentration of salt in four cells and in the water around each cell. In which diagram will water enter the cell?



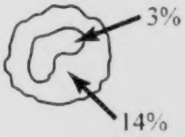
A



* **B**

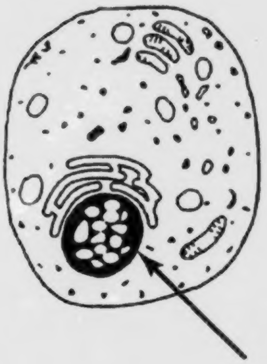


C



D

3 Study the drawing below.



What is the arrow pointing to in this drawing?

A vacuole

* **B** nucleus

C cell membrane

D mitochondrion

4 When comparing human cells to bacteria, which of these statements is true?

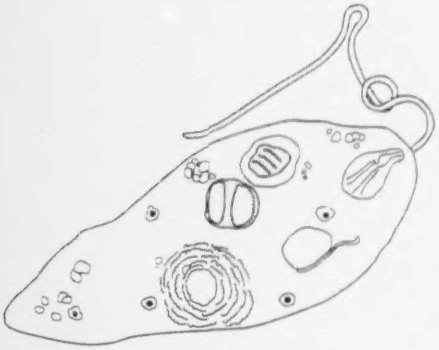
A Human cells and bacteria both have nuclei.

B Human cells and bacteria both have cell walls.

* **C** Human cells have membrane-bound nuclei; bacteria do not.

D Human cells do not have membrane-bound nuclei; bacteria do.

5 Study the picture below.



The part of this euglena that enables it to move is its

- * **A** flagella
- **B** cytoplasm
- **C** cilia
- **D** contractile vacuole

6 Cellulose fibers are present in

- **A** both plant and animal cells
- **B** neither plant nor animal cells
- **C** animal cells but not plant cells
- * **D** plant cells but not animal cells

7 If a blood cell is placed in pure water it will die because

- **A** water diffusing out will dehydrate it
- * **B** water diffusing in will cause it to burst
- **C** carbon dioxide will be unable to diffuse out
- **D** cell organelles will diffuse through the membrane

8 Which of these are found in plant cells but not in animal cells?

- **A** vacuoles
- **B** ribosomes
- * **C** starch grains
- **D** mitochondria

9 Study the list below.

1. cell
2. tissue
3. organ
4. system

What is the correct order for these body structures from least inclusive to most inclusive?

- **A** 1, 3, 4, 2
- **B** 3, 2, 1, 4
- * **C** 1, 2, 3, 4
- **D** 4, 3, 2, 1

10 The difference between a eukaryotic and a prokaryotic organism is in its

- **A** function
- **B** environment
- * **C** cell structure
- **D** feeding habits

11 A cell with a low concentration of iodine is placed into a water solution with a high concentration of iodine. Which of these should occur?

* **A** Iodine will move into the cell, increasing the solution concentration inside the cell.

B Iodine will move out of the cell, decreasing the solution concentration inside the cell.

C Iodine will be produced inside the cell until concentrations are equal inside and outside the cell.

D Iodine movement is constant, and concentrations will remain the same inside and outside the cell.

12 In the lungs, oxygen is present in higher concentration in the alveoli than in the blood. Carbon dioxide is present in higher concentration in the blood than in the alveoli. The exchange of oxygen and carbon dioxide between the alveoli and blood is accomplished through

A endocytosis

B exocytosis

C energy transport

* **D** passive transport

13 Which of these is NOT a characteristic of a euglena?

* **A** It has cilia.

B It is unicellular.

C It moves by means of flagella.

D It is found mostly in fresh water.

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STANDARD V: The student will understand concepts of cells.

OBJECTIVE

2. Differentiate between mitosis and meiosis.

ELIGIBLE CONTENT

- Define, contrast, and compare mitosis and meiosis—may include events needed to prepare the cell for these processes.
- Describe the purpose of mitotic and meiotic divisions during different life stages of organisms—such as asexual and sexual reproduction and growth and repair.

SAMPLE ITEMS

1 The process of meiosis

A creates only two cells

B makes diploid cells

C is used for asexual reproduction

* **D** makes haploid cells

2 The action of meiotic cell division in a human can

* **A** determine sex-related traits in an offspring

B increase by one-half the number of genes in an offspring's cells

C reduce by one-half the number of genes in an offspring

D double the number of chromosomes in an offspring's cells

3 Which of these produces spores by sexual reproduction?

A mitosis

* **B** meiosis

C symbiosis

D transpiration

4 Which of these is NOT true about meiosis?

A disjunction occurs

B crossing over occurs

C chromosomes separate twice

* **D** chromosomes separate only once

STANDARD VI: The student will understand concepts of interdependence.

OBJECTIVE

1. Demonstrate an understanding of factors that affect the dynamic equilibrium of populations and ecosystems.

ELIGIBLE CONTENT

- Describe the harmful/beneficial consequences of introducing a non-native species into an ecosystem.
- Identify species that are competing for resources and predict outcomes of that competition.
- Identify and define biotic and abiotic components of different environments.
- Determine how viruses, bacteria, and parasites affect the dynamic equilibrium of populations.
- Identify human activities that affect the dynamic equilibrium of populations and ecosystems.
- Identify factors and relationships—such as predator/prey—that affect population dynamics and ecosystems.
- Explain why diversity within a species is important and how heritable traits ensure survival.

SAMPLE ITEMS

1 Gypsy moths in the eastern United States occasionally reproduce in large numbers and cause great damage to the hardwood forests. A certain parasitic wasp paralyzes the gypsy moth caterpillar and lays its eggs on the caterpillar's body. After the eggs hatch, the wasp larvae eat the caterpillar. Soon, few gypsy moths remain. What does this demonstrate?

A Parasitic wasps are better adapted to their environment than the gypsy moths.

B Gypsy moths are better adapted to their environment than the parasitic wasps.

* **C** Parasitic wasps and gypsy moths represent an example of population equilibrium.

D Gypsy moths are an example of the risks of introducing non-native species into hardwood forest environments.

2 An African snail brought to Hawaii became a plant-eating pest. To control the African snails, 19 snail-eating species were imported to Hawaii from all over the world. One of the imports, the cannibal snail, has nearly destroyed the native Hawaiian tree snail population.

What is the MOST important conclusion suggested by the passage above?

A Snails eat plants.

B Snails eat each other.

C Imported species usually cannot survive.

* **D** Imported species may upset biological balances.

3 In the 1970s, it was found that small concentrations of pesticides in the water resulted in large concentrations of pesticides in organisms at the top of some food chains. The BEST explanation for this is that organisms at higher levels in a food chain

* **A** eat large numbers of organisms from lower levels

B generate more offspring

C are more sensitive to pesticides

D live longer than those at lower levels so they have more pesticide exposure

4 Which of these will happen in a forest ecosystem when the number of fungi and bacteria in the food web decreases?

A Decomposition occurs at a faster rate.

* **B** Fewer nutrients are returned to the soil.

C More matter cycles through the ecosystem.

D The amount of energy in the ecosystem increases.

5 In cold, hard winters when prey are diminished, only the best-adapted wolves are able to obtain food and live to reproduce. This illustrates which of the following concepts?

* **A** The fitness of an organism will determine its survival.

B Living organisms are necessary to produce other living organisms.

C The physical traits of an individual can be transmitted to its offspring.

D Organisms that migrate to new environments are less likely to survive.

6 An ecological system is best defined as

A a large region of Earth that has similar kinds of organisms

B a classification system that groups living things according to common characteristics

C a theory that attempts to explain how groups of organisms change to become better suited to their environment

* **D** a combination of living and nonliving parts of an environment that is self-supporting when considered as a whole

7 A sharp drop in the numbers of one consumer population in an ecosystem would most likely be caused by a

A falling birth rate

* **B** bacterial disease

C change in eating habits

D decrease in secondary consumers

8 Which of these is NOT an inherited trait that could help a species survive over time?

A the shape of a finch's beak

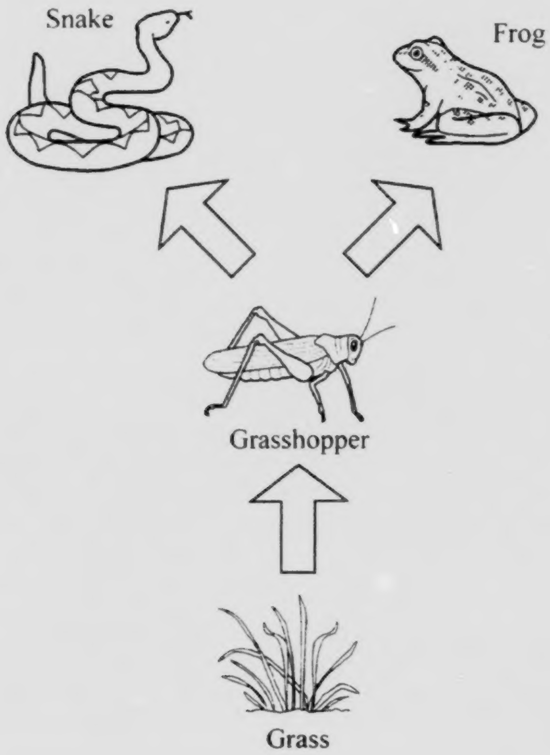
B the thickness of a bear's fur

C a rabbit's instinct for avoiding predators

* **D** a human's resistance to disease by vaccination

9 Read the paragraph and study the drawing below.

Grasshoppers feed off plants and may eventually kill them. Snakes and frogs eat grasshoppers to survive. A farmer is growing crops and has grasshoppers, snakes, and frogs living among these crops.



If the population of frogs doubles, which of the following will probably happen?

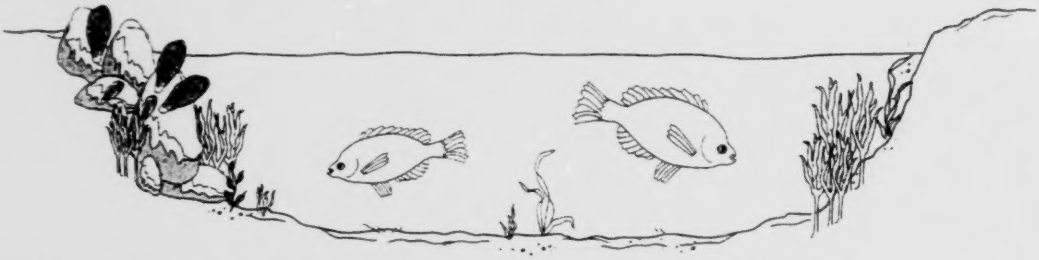
A The population of grasshoppers will increase.

* **B** The population of grasshoppers will decrease.

C The population of grasshoppers will remain the same.

D The populations of grasshoppers and snakes will increase.

10 Study the picture below.



Which of these is NOT a biotic factor of a marine environment?

A fish

B seaweed

* **C** water

D mussels

11 Which of these factors is the MOST important in limiting plant growth under the canopy of a tropical rain forest?

* **A** light

B fungi

C water

D insects

STANDARD VII: The student will understand concepts of energy.

OBJECTIVE

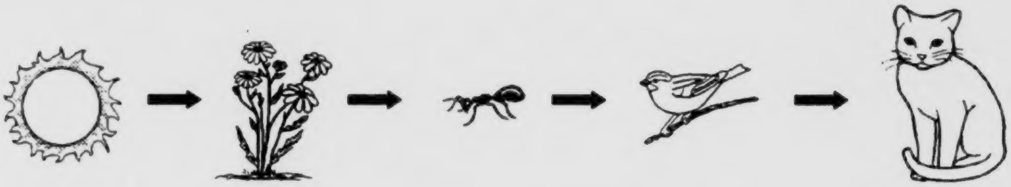
1. Relate the Law of Conservation of Energy to energy transformations.

ELIGIBLE CONTENT

- Describe how energy—mechanical, electrical, chemical, light, sound, and heat—can be transformed from one form to another.
- Show understanding that energy transformations result in no net gain or loss of energy, but that in energy conversions less energy is available due to heat loss during the transformations.
- Apply the concept of conservation and transformation of energy within and between organisms and the environment—such as food chains, food webs, and energy pyramids.

SAMPLE ITEMS

1 Study the food chain below.



The relationship between the energy emitted by the sun and the energy received by the cat in this system is

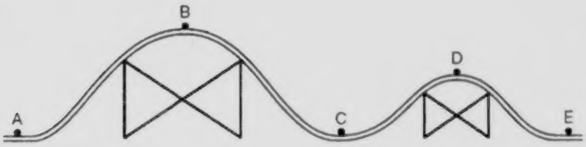
A the cat receives the same amount of energy that was emitted by the sun

B none of the energy emitted by the sun will be transmitted through the food chain to reach the cat

* **C** the sun emits more energy than is transmitted through the food chain, but the cat receives some energy

D the cat receives more energy than the energy emitted by the sun because the amount of energy increases as it moves through the food chain

Use the diagram below to answer Numbers 2 and 3.



2 A roller coaster starts at point A and is pulled to a stop at point B, where it falls freely toward point C. At what point on the track will the roller coaster have the GREATEST potential energy?

A point A

* **B** point B

C point C

D point D

3 A roller coaster starts at point A and is pulled to a stop at point B, where it falls freely toward point C. Which equation correctly describes the transformation of the roller coaster's energy from point C to point D?

A kinetic energy at point C = potential energy at point D

B potential energy at point C = potential energy at point D

* **C** kinetic energy at point C = potential energy at point D + heat

D potential energy at point C + heat = kinetic energy at point D

4 All food chains involve the transfer of energy from one level to another. The organisms at each level store energy. The organisms at the level which store the greatest amount of energy are

* **A** producers

B herbivores

C carnivores

D decomposers

5 In all ecosystems there are fewer organisms at the top of a food pyramid than at the bottom. For example, fewer hawks than mice inhabit wildlife areas. Why is this the case?

* **A** Only a small percentage of the consumer's food is stored as living tissue.
- **B** Producers depend on a wider variety of food sources for their nutrition.
- **C** The use of pesticides has caused more of the organisms at the top to die out.
- **D** Humans have encroached on the habitats of organisms at the top of the food pyramid.

6 Which of these processes involves the transformation of light energy into chemical energy?

- **A** digestion
- **B** respiration
- **C** perspiration
* **D** photosynthesis

7 Energy is transferred through organisms in each step of a food chain. Suppose there are 5000 calories available at the producer level in a food chain. Only approximately 10% of the energy from one level can be utilized by the next level. How many calories would be available for a secondary consumer (3rd level)?

* **A** 50
- **B** 500
- **C** 5000
- **D** 50,000

8 Which of these can NOT be directly transformed into mechanical energy?

- **A** light
* **B** matter
- **C** sound
- **D** electricity

9 In any energy transformation, the greatest amount of energy is lost through

* **A** heat
- **B** light
- **C** mechanical inefficiency
- **D** endothermic reactions

10 Which of these energy transformations occurs when music causes the human eardrum to vibrate?

- **A** Heat energy is converted to electrical energy.
- **B** Kinetic energy is converted to potential energy.
* **C** Sound energy is converted to mechanical energy.
- **D** Mechanical energy is converted to chemical energy.

STANDARD VII: The student will understand concepts of energy.

OBJECTIVE

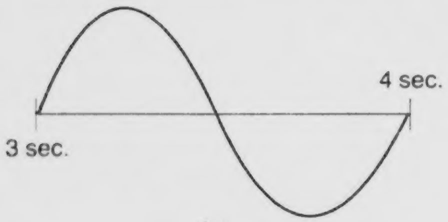
2. Relate waves to the transfer of energy.

ELIGIBLE CONTENT

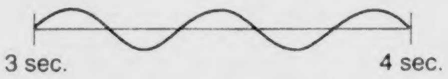
- Relate wavelength to energy.
- Describe how waves travel through different kinds of media.
- Describe how waves—earthquake waves, sound waves, water waves, and electromagnetic waves—can be destructive/beneficial due to the transfer of energy.

SAMPLE ITEMS

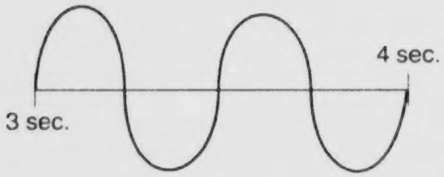
1 Which of these electromagnetic waves has the least amount of energy?



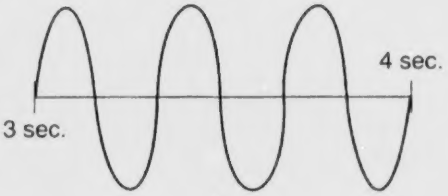
***A**



C



B



D

2 Study the table below.

Substance	Speed of Sound at 20°C
Water	1500 m/s
Iron	5130 m/s
Glass	5500 m/s
Air	344 m/s
Mercury	1407 m/s
Carbon dioxide	277 m/s

Through which of these media does sound travel the fastest?

A gas

* **B** solid

C liquid

D plasma

3 Water waves move up and down because

A their frequency is changing

* **B** energy is passing through them

C water pressure is building in them

D water molecules expand and contract

4 Which of the following BEST describes the principle by which an x-ray machine works?

A High-frequency sound waves pass through both teeth and bones.

B High-frequency sound waves pass through skin and muscle but not bones.

* **C** More electromagnetic waves pass through skin and muscle than pass through bones and teeth.

D More electromagnetic waves pass through bones and teeth than pass through skin and muscle.

5 Each of these statements about the speed of different kinds of waves is true EXCEPT that

A sound waves depend on air temperature

* **B** radio waves depend on atmospheric pressure

C water waves depend on the depth of the water

D waves in a rope depend on the tension of the rope

6 Which of these does NOT happen as a wave travels through water in the middle of a pond?

A Energy is transferred.

B A disturbance travels through the water.

* **C** The water molecules travel with the wave.

D The arrangement of water molecules changes as the wave travels.

7 At 20°C, through which of these materials does sound move the slowest?

* **A** air

B iron

C water

D alcohol

8 Electromagnetic radiation produces beneficial visible light, but it can also be destructive. High energy electromagnetic waves can burn skin or ionize water molecules. Which of these electromagnetic waves can be the MOST damaging to humans?

A x-rays

* **B** gamma rays

C infrared rays

D ultraviolet rays

STANDARD VIII: The student will understand concepts of force and motion.

OBJECTIVE

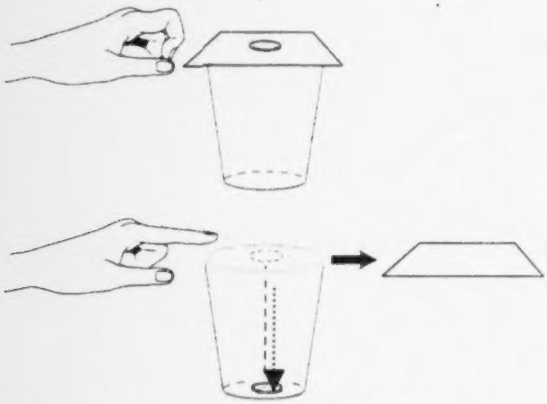
1. Relate Newton's three laws of motion to real-world applications.

ELIGIBLE CONTENT

None specified.

SAMPLE ITEMS

1 Study the pictures below.



There is a coin on top of a piece of paper covering a glass. When the paper is quickly flicked from under the coin, the coin drops to the bottom of the glass.

Which law is demonstrated by the behavior of the coin in the pictures?

A For every action there is an equal and opposite reaction.

* **B** Objects at rest tend to remain at rest unless acted upon by an outside force.

C Energy can be changed from one form to another but cannot be made or destroyed.

D The net force applied to an object determines the rate of acceleration of that object.

2 As a football play begins, a lineman from one team pushes the opposing lineman backward. This is an example of

A a balanced force

B the force of gravity

C the force of friction

* **D** an unbalanced force

3 What property of a stalled car determines how much effort is required to move it?

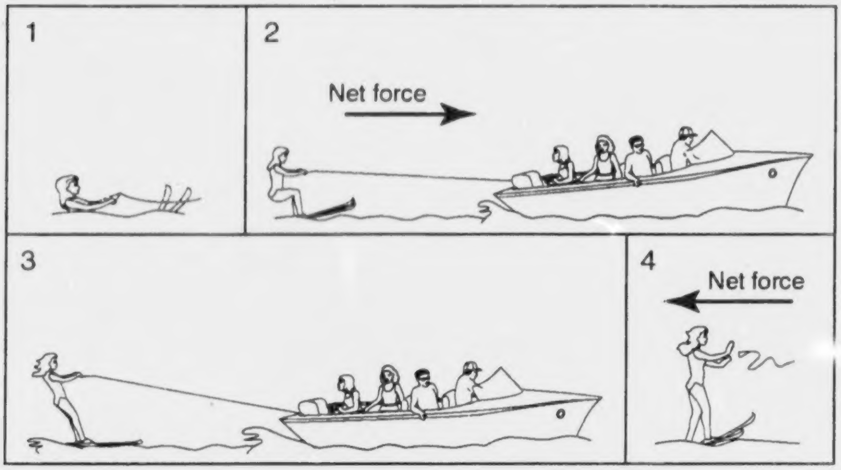
* **A** mass

B height

C volume

D density

4 The following drawing shows a water skier at different stages. Picture 1 shows the skier floating still in the water. Picture 2 shows the skier being pulled out of the water as the boat begins to move. Picture 3 shows the skier being pulled at a constant velocity. Picture 4 shows the skier letting go of the ski rope.



When does the water skier experience zero acceleration?

A at point 1 only

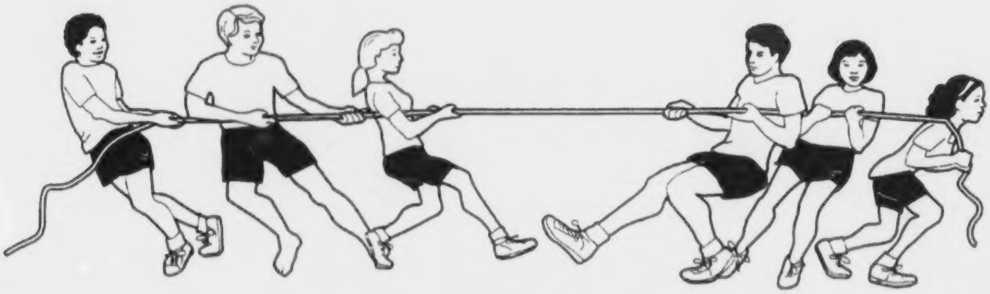
* **B** at points 1 and 3

C at point 4 only

D at points 2 and 4

230

5 Study the picture below.



Two groups of three people are playing a game of tug-of-war, pulling each end of a rope in opposite directions. Group X pulls with a force of 800 N in the western direction; Group Y pulls 1000 N in the eastern direction.

This tug-of-war game illustrates

A the force that gravity exerts on each group of people

B that one group of people is in equilibrium with the other

* **C** that each group of people is experiencing a form of acceleration

D the reaction forces that one group of people is exerting on the other group

6 Susie is driving along a road when a cat suddenly jumps out in front of her car. Susie slams on the brakes and lunges forward in her seatbelt.

Why did Susie lunge forward when she hit the brakes?

A The car's momentum was transferred to Susie.

* **B** The brakes stopped the car's inertia but not Susie's.

C The seat of the car pushed Susie forward in the seatbelt.

D Gravity helped stop the heavy car faster than it stopped Susie.

7 A car moves along a road at a high speed. The driver pushes the gas pedal down farther, generating a forward force of 3000 N on the car. A strong gust of wind hits at the exact moment the driver pushes the gas pedal, exerting a backward force of 2500 N on the car. The road also applies a backward force of 500 N due to friction.

What is the acceleration of the car at the exact moment the gust of wind hits the car?

* **A** 0 m/s^2

B 500 m/s^2

C 2500 m/s^2

D 3000 m/s^2

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STANDARD VIII: The student will understand concepts of force and motion.

OBJECTIVE

2. Relate force to pressure in fluids.

ELIGIBLE CONTENT

- Relate force to pressure in fluids. (Note: Formulas will be provided, where needed, to calculate fluid force in closed systems.)
- Apply the concept of fluid pressure to biological systems—such as in strokes, aneurysms, the bends, blood pressure, lung function, equalization of pressure on the eardrum, and turgor pressure.

SAMPLE ITEMS

1 If the turgor pressure in a plant cell is lowered, the cell will

* **A** shrink
B grow
C burst
D stay the same

2 Which of these plays a role in making it possible for water to rise 300 feet inside giant redwood trees?

A intense sunlight
B nutrient-rich soil
* **C** transpiration pull
D lack of competitors

3 Smoking and high cholesterol diets can increase the risk of atherosclerosis, which is the buildup of fatty deposits that clog the insides of arteries.

What effect could atherosclerosis have on the human circulatory system?

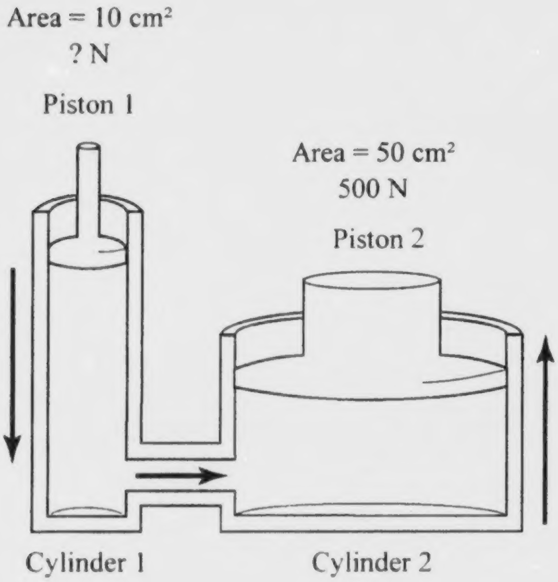
$$Pressure = \frac{Force}{Area}$$

* **A** increase blood pressure
B increase the inside diameter of arteries
C decrease volume of blood in the body
D decrease force of blood pumped from the heart

4 Read the paragraphs and study the diagram below.

A hydraulic lift is a machine used to raise heavy loads. In this type of machine, a fluid is contained within two cylinders that are connected. The fluid can flow freely between the two cylinders. There is a piston in each cylinder that moves up and down.

In the diagram below, Cylinder 1 of the hydraulic lift has a cross-sectional area of 10 cm^2 while Cylinder 2 has a cross-sectional area of 50 cm^2. Since the cylinders are connected in a closed system, a downward force applied to Piston 1 will result in an upward force on Piston 2.



If an unknown force is applied to Piston 1, which of these statements is true?

A The pressure inside the cylinders will remain unchanged.

* **B** The pressure on Piston 1 is equal to the pressure on Piston 2.

C The pressure on Piston 2 is greater than the pressure on Piston 1.

D The force that Piston 2 applies will be smaller than the unknown force.

5 Deep sea divers may experience ear problems because as the divers descend,

A the pressure within the ear decreases to compensate for the increasing water pressure

B the pressure within the ear becomes greater than the surrounding water pressure

* **C** the surrounding water pressure becomes greater than the pressure within the ear

D the surrounding water pressure and the pressure within the ear begin to fluctuate rapidly

6 A stroke occurs when an artery in the brain becomes blocked. In the case of a stroke, the section of artery located before the point of blockage will

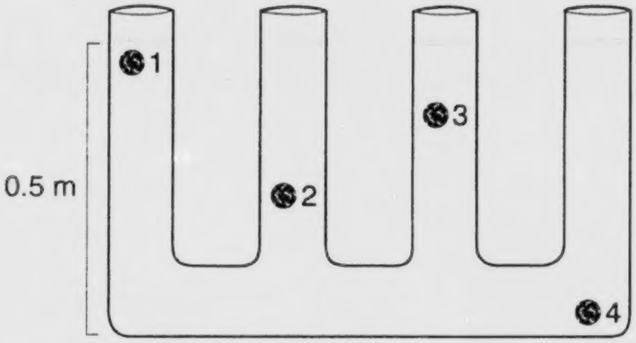
A have less blood pressure

B initiate the production of red blood cells

C initiate the production of clotting factors

* **D** have greater blood pressure

7 Study the drawing below.



Which marble is under the greatest pressure?

A marble 1

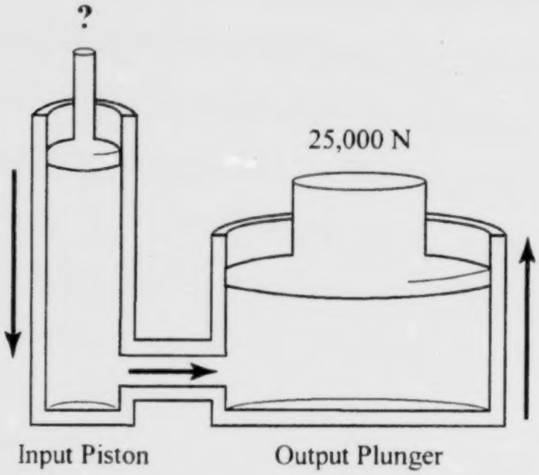
B marble 2

C marble 3

* **D** marble 4

8 Read the paragraph and study the diagram below.

In a hydraulic car lift, the Input Piston has a surface area of 0.01 m^2. The Output Plunger has a surface area of 0.5 m^2. A downward force at the Input Piston creates pressure in the fluid-filled cavity, causing an upward force on the Output Plunger.



What force must be applied to the Input Piston to generate a force of 25,000 N on the Output Plunger?

$$\frac{F_1}{F_2} = \frac{A_1}{A_2}$$

A 2.5 N

B 125 N

* **C** 500 N

D 2500 N

9 Which of these is sometimes caused by high blood pressure?

* **A** the wall of an artery dilates and forms a sac

B more blood vessels develop to supply the tissues

C oxygen-rich and oxygen-poor blood become mixed in the blood

D an increase in the total amount of fluid in the circulatory system

F. ITEM SPECIFICATIONS: READING COMPREHENSION

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INTRODUCTION

This bulletin provides specific information about the *Alabama High School Graduation Exam*, Third Edition (AHSGE). Educators representing each state school board district as well as both city and county school systems served on the committees that determined the standards and objectives; determined the eligible content for the test; and reviewed, revised, and approved the actual items.

The standards and objectives for the AHSGE are also found in *Standards and Objectives* (*Reading Comprehension, Language, Mathematics, and Science*) *for the Alabama High School Graduation Exam*, Bulletin 1997, No. 16, and *Standards and Objectives* (*Social Studies*) *for the Alabama High School Graduation Exam*, Bulletin 1998, No. 13. The standards and objectives for reading are specifically referenced in this document.

Teachers must be familiar with this document if they teach content that relates to the objectives measured on the graduation exam in the middle grades or in the high school grades. Further, teachers must use this document in focusing instruction for students who have demonstrated weaknesses on objectives measured on the pre-graduation examination and the AHSGE.

An item specification has a distinct purpose and provides essential information concerning the testing of an objective. Item specifications for reading will follow this order:

STANDARD	Broad area of content to be assessed
OBJECTIVE	Specific skill within a standard to be assessed
ELIGIBLE CONTENT	Clarification and elaboration of an objective (where applicable)
SAMPLE ITEMS	Item formats to test each objective

The sample items in this bulletin will **not** be found on the pre-graduation examination or the AHSGE. The number of sample items in this bulletin does not necessarily reflect the weight of the content on the test. In order to identify the weight of the content, the following chart shows the number of items for each reading objective.

OBJECTIVES		NUMBER OF ITEMS
I-1	Identify supporting details	6
I-2	Determine sequence of events	6
I-3	Follow directions	6
II-1	Identify main idea	6
II-2	Draw conclusions	6
II-3	Determine cause and effect	6
II-4	Propaganda; Fact from opinion	6
II-5	Recognize summary statements	6
III-1	Recognize logic and arguments	6
III-2	Analyze literary elements	6
III-3	Understand figurative language	6
IV-1	Determine meaning of words	6
IV-2	Preview, predict	6 items combined
IV-3	Discern organizational patterns	
IV-4	Demonstrate reference material usage	6
TOTAL		84

Educators from each state school board district as well as both city and county school systems served on a committee to select appropriate reading passages to be included on the reading comprehension test. The committee members considered passages individually in order to determine their appropriateness. Some of the criteria used to judge each passage included length, difficulty level, interest level, age appropriateness, and appropriateness for students of special populations.

Most passages have been taken from authentic sources. Some have been edited to avoid possible bias or for reasons of length or appropriateness. Reading passages on the AHSGE may be broadly categorized as these three text types:

Textual materials generally read for information, such as charts, graphs, encyclopedias, news magazines, essays, lab manuals, and material found in textbooks.

Recreational materials generally read for pleasure, such as magazines, poetry, novels, and short stories.

Functional materials generally read for a precise action, such as directions, maps, schedules (television, bus), menus (computer, restaurant), catalogues, instructions, and other material generally encountered in everyday life beyond the classroom.

On each reading test, approximately half the reading passages are textual; the other half of the test is split between recreational and functional reading materials. The passages may range in length from a single page to three pages, with a total of 12–14 passages on each reading test. Each reading passage measures more than one objective.

PASSAGES

WITH ITEMS

Read the following article and poem and answer Numbers 1 through 9. You may look back at the article and poem as often as you like.

Dorothy Parker

more than just a wit

by Lisa Burdige

Dorothy Parker was famous for saying what was on her mind. In fact, her biting, clever jibes are the stuff of literary legend. But Parker was more than just a wit; she was an acclaimed poet, short-story writer, journalist, and screenwriter whose 28 films included *A Star Is Born*. She was also the brightest light of the Algonquin Round Table, an assemblage of writers who met every day at the Algonquin Hotel in New York City from 1919 into the forties, and did much to shape American popular culture.

Little is known about Dorothy Parker's early life. She was born Dorothy Rothschild in 1893. Her mother died in Dorothy's infancy, and Dorothy was raised in New York City, where she attended a Catholic convent school. She later said the only thing school taught her was that "if you spit on a pencil eraser, it will erase ink." Left without an income when her father died, the twenty-year-old Parker began her career, first as a copywriter for *Vogue* then, one year later, as drama critic for *Vanity Fair*. For four years she brought her distinctive brand of biting wit to her reviews. For example, of Katherine Hepburn's performance in a Broadway play, she wrote, "Ms. Hepburn ran the whole gamut of emotions from A to B."

Parker's stories, however, show another side of the writer. "Dear God," she wrote in a letter to a friend, "please make me stop writing like a woman." For Parker, "writing like a woman" meant scrutinizing the foibles and, often, the falsity of romance. Her accomplished, pained tales of love and betrayal are very different from her hard-edged public persona.

Over the span of her career, Parker wrote 51 short stories, 4 volumes of verse, several volumes of nonfiction and essays, a detective novel, 28 screenplays, and several plays. She received the O. Henry Award for her story "Big Blonde" in 1929. Harold Ross, founder of *The New Yorker* magazine, credited Parker with the creation of *The New Yorker* short story, though Parker herself denied that such a genre existed. Throughout her career, Parker was esteemed as a writer of sophistication, skill, and insight, but by the end of her life, she had almost disappeared from public view.

After the death of Alan Campbell[1] in 1963, Parker told a friend, "I'm seventy and feel ninety. If I had any decency, I'd be dead. Most of my friends are." She died in 1967 at the age of seventy-four. Willing to pun at anyone's expense, including her own, she had written the epitaph for her own tombstone, which reads, "Excuse my dust."

---

[1] Parker was married to Alan Campbell but kept the name of her first husband.

Excerpt from "Dorothy Parker: More Than Just a Wit" by Lisa Burdige from *Literary Cavalcade*'s April 1995 issue, copyright © 1995 by Scholastic, Inc. Used by permission of Scholastic, Inc.

Now read one of Dorothy Parker's poems, "One Perfect Rose."

ONE PERFECT ROSE

by Dorothy Parker

A single flow'r he sent me, since we met.
All tenderly his messenger he chose;
Deep-hearted, pure, with scented dew still wet—
One perfect rose.

I knew the language of the floweret;
"My fragile leaves," it said, "his heart enclose."
Love long has taken for his amulet[2]
One perfect rose.

Why is it no one ever sent me yet
One perfect limousine, do you suppose?
Ah no, it's always just my luck to get
One perfect rose.

---

[2] **amulet:** an object worn as a charm

1 The main idea of this article is that Dorothy Parker

A lost her sense of humor at the end of her life.

B is best known for her screenplay *A Star Is Born.*

C often wished that she could write without using humor.

D is famous for both her wit and her insightful tales of love.

2 How did Dorothy Parker begin her career as a writer?

A as a copywriter for *Vogue*

B as a student at convent school

C as a drama critic for *Vanity Fair*

D as a member of the Algonquin Round Table

3 When Dorothy Parker wrote, "Dear God, please make me stop writing like a woman," she meant she would rather write

A with a masculine style.

B without using her wit.

C about something she knows.

D about something other than romantic love.

4 What can the reader conclude about Dorothy Parker's time in school?

A She learned many practical skills.

B She cared little about her education.

C She wrote many humorous essays that got her in trouble.

D She learned everything she needed to know to become a great writer.

"One Perfect Rose" by Dorothy Parker, copyright © 1926, renewed © 1954 by Dorothy Parker, from *The Portable Dorothy Parker* by Dorothy Parker. Used by permission of Viking Penguin, a division of Penguin Putnam, Inc.

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5 What is the theme of the poem?

A Love will last no matter what gifts are given.

B Women desire more than symbolism in a gift.

C Love should be shown through inexpensive gifts.

D Women know a single rose is a better gift than jewelry.

6 What is the tone of the poem?

A angry

B ironic

C tender

D dramatic

7 Who or what is the messenger in the line, "All tenderly his messenger he chose"?

A flower

B limousine

C amulet

D heart

8 Which part of the poem demonstrates Dorothy Parker's wit?

A "A single flow'r he sent me, since we met."

B "Deep-hearted, pure, with scented dew still wet—"

C "Love long has taken for his amulet/One perfect rose."

D "Why is it no one ever sent me yet/One perfect limousine?"

9 What can the reader conclude from the poem about Dorothy Parker's attitude toward roses?

A She appreciates roses as examples of perfection.

B She believes roses symbolize a romantic relationship.

C She thinks roses are a poor substitute for time spent traveling.

D She feels roses are fine but she would like something more substantial.

Read the following newspaper column and answer Numbers 1 through 7. You may look back at the newspaper column as often as you like.

In and of Ourselves We Trust

by Andy Rooney

"In and of Ourselves We Trust" was one of Rooney's syndicated columns. Rooney's piece uses one simple example to illustrate a generality. He draws from it a far-reaching set of conclusions: that we have a "contract" with each other to stop for red lights—and further, that our whole system of trust depends on everyone doing the right thing.

Last night I was driving from Harrisburg to Lewisburg, Pennsylvania, a distance of about 80 miles. It was late, I was late, and if anyone asked me how fast I was driving, I'd have to plead the Fifth Amendment to avoid self-incrimination.

At one point along an open highway, I came to a crossroads with a traffic light. I was alone on the road by now, but as I approached the light, it turned red, and I braked to a halt. I looked left, right, and behind me. Nothing. Not a car, no suggestion of headlights, but there I sat, waiting for the light to change, the only human being, for at least a mile in any direction.

I started wondering why I refused to run the light. I was not afraid of being arrested, because there was obviously no cop anywhere around and there certainly would have been no danger in going through it.

Much later that night, after I'd met with a group in Lewisburg and had climbed into bed near midnight, the question of why I'd stopped for that light came back to me. I think I stopped because it's part of a contract we all have with each other. It's not only the law, but it's an agreement we have, and we trust each other to honor it: We don't go through red lights. Like most of us, I'm more apt to be restrained from doing something bad by the social convention that disapproves of it than by any law against it.

It's amazing that we ever trust each other to do the right thing, isn't it? And we do, too. Trust is our first inclination. We have to make a deliberate decision to mistrust someone or to be suspicious or skeptical.

It's a darn good thing, too, because the whole structure of our society depends on mutual trust, not distrust. This whole thing we have going for us would fall apart if we didn't trust each other most of the time. In Italy they have an awful time getting any money for the government because many people just plain don't pay their income tax. Here, the Internal Revenue Service makes some gestures toward enforcing the law, but mostly they just have to trust that we'll pay what we owe. There has often been talk of a tax revolt in this country, and our government pretty much admits that if there were a widespread tax revolt here, they wouldn't be able to do anything about it.

We do what we say we'll do. We show up when we say we'll show up.

I was so proud of myself for stopping for that red light. And inasmuch as no one would ever have known what a good person I was on the road from Harrisburg to Lewisburg, I had to tell someone.

"In and of Ourselves We Trust" by Andy Rooney, copyright © Tribune Services, Inc. All rights reserved. Reprinted by permission.

1 Which set of statements BEST summarizes this newspaper column?

A The Internal Revenue Service needs to enforce stronger tax laws. Otherwise, no one will pay taxes.

B The stability of society is built on trust. Without trust the contract we have with each other would be destroyed.

C If we did not trust each other, there would be a tax revolt. The contract we have with each other would be destroyed.

D Through trusting each other to obey laws, we build a solid government. We must have a strong police force in order to ensure that stability.

2 What is the most convincing reason Rooney gives for not going through the red light?

A It is against the law.

B We just don't go through red lights.

C It is part of a contract we have with each other.

D We stop in this situation because it makes us feel proud.

3 Rooney's statement "We do what we say we'll do. We show up when we say we'll show up" supports his belief that Americans are

A proud.

B prompt.

C trustworthy.

D complacent.

4 Why does Rooney change from "I" to "we" about halfway through the newspaper column?

A to urge readers to obey traffic laws

B to enable readers to understand the social contract

C to encourage readers to identify with his point of view

D to lead readers to consider conventions more important than laws

5 When does Andy Rooney decide that he stopped at the red light "because it's part of a contract we all have with each other"?

A after he goes to bed

B while braking for the light

C during his wait at the light

D before he reaches Lewisburg

6 What is the main idea of this newspaper column?

A We must trust each other in order to have a stable society.

B We stop at red lights because we obey social conventions.

C We should pay our taxes even when we don't agree with the government.

D We tell others about our honesty so they will be more likely to follow the rules.

7 What can you conclude about Andy Rooney from this newspaper column?

A He believes most people mistrust others.

B He considers himself a law-abiding citizen.

C He thinks that he is perfect.

D He trusts the Internal Revenue Service.

Read the following true story and answer Numbers 1 through 8. You may look back at the story as often as you like.

Just Two Points Make One Dream Come True

by Mitch Albom

TUCSON, Ariz.—He didn't want much. Just one basket. That's not a lot to ask from a college career, is it? One basket?

For this, he would work. For this, he would sacrifice. For this he would sit at the end of the bench, night after night, year after year. Without a scholarship. Without fame. He would travel to cities, dress in the uniform, go through warm-ups. Then take off the uniform, travel back home, go to class. Year after year. Night after night.

One basket.

Sean Dobbins is the other side of the Fab Five. The far side. He was a good little high school basketball player who chose Michigan, like most kids, to get an education. He paid his own tuition. No one recruited him.

One day, early in his freshman year, Dobbins got an idea. He took his high school scrapbook to the basketball office and asked to see Steve Fisher.

"Coach, I'd like to play for your team," he said. "These are some articles about me in high school."

Fisher, who had just won a national championship, was amused. Big-time college basketball schools begin recruiting players when they are in eighth or ninth grade. They follow them—hound them, sometimes—until they sign. Only the best get taken.

Now here was a kid with a scrapbook.

"I'll take a look," Fisher said.

Finding room on the roster

Five weeks later—to everyone's surprise—Dobbins was on the team. A walk-on. True, he still had to pay his own tuition. True, he was mostly there to help practice. But the kid with the scrapbook was in the club, dressing next to stars like Rumeal Robinson and Terry Mills.

He went through drills. He sweated every scrimmage. He dressed for the games, but almost never got in. To be honest, it was a big deal if he unzipped his sweat suit.

Sophomore year, he made a free throw.

That was the highlight of his season.

"I still dreamed about making a basket," he says. "I figured I had two years left."

Then, a setback. Michigan recruited five star freshmen—the Fab Five—and there was no room on the team for Dobbins. He spent his junior year practicing in the gym with other students. When the NCAA tournament came around, he drove to Atlanta, on his own. And he drove to Lexington. And he drove to Minneapolis. He sat behind the team, in the stands, longing to be part of it again, to wear the uniform, to maybe get a shot at that one basket he'd been dreaming about since freshman year.

Suddenly, he was a senior.

"Just Two Points Make One Dream Come True" by Mitch Albom from the *Detroit Free Press* March 21, 1993 issue, copyright © 1993 by the *Detroit Free Press*. Reprinted by permission.

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The free throw just didn't count

"The guys on the team were really pulling for me now," he says. Given his old spot back—and the fact that because U-M was so talented, there should be plenty of "garbage time"—Dobbins was optimistic. He practiced hard, as usual. He dressed and undressed, as usual.

But the games slipped away. Pretty soon, it was the regular-season finale against Northwestern, and Dobbins still hadn't scored a hoop. Fisher put him in, and he quickly took a shot—which clanked off the rim. The crowd moaned. In the final seconds he got the ball again, spun toward the basket and—AHNNNNNNN!

The buzzer sounded. The season was gone. And so, Dobbins figured, was his chance.

Which is what made Friday night so special. Friday night, first game of the NCAA tournament, the most serious basketball of the year. Michigan found itself ahead by 30 points late against Coastal Carolina. Fisher looked down the bench, saw the kid with the scrapbook, and said, "Get in there."

This time, the whole U-M team, which had come to love Dobbins for his never-quit spirit, was ready. With four seconds left, and a free throw about to be shot at the opposite end, the Wolverines called Dobbins over and hid him in their midst. "Don't move," they whispered, "just wait." The other team didn't even see him.

So when the free throw was made, Rob Pelinka grabbed the ball, and heaved it downcourt to Dobbins, who stepped out of the camouflage and was suddenly all alone.

"All I could think was 'Catch it! Catch it!'" Dobbins said.

He caught it. He dribbled toward the basket. Three seconds. Two seconds. He laid it up . . . and in!

Score! The buzzer sounded. And the Wolverines mobbed Dobbins as if he'd just won a championship. "You shoulda dunked it!" laughed Chris Webber. "DOBBS! DOBBS!" yelled Juwan Howard, grabbing him in a headlock and carrying him to the locker room.

We watch so much college basketball, we forget that they are kids out there. Kids with dreams. Some dream of winning it all. Some just dream of scoring two points.

"It was the greatest moment of my life," said Dobbins. "If I never scored, the experience would still have been worthwhile. But now, it feels . . . great."

Mission accomplished.

Unless any NBA teams are interested . . .

1 What is a major theme in this story?

- **A** It takes commitment to reach a goal.
- **B** It takes conviction to sit on the bench.
- **C** It takes persistence to get an education.
- **D** It takes concentration to make a basket.

2 Why does Fisher think it is funny when Dobbins wants to join the Wolverines?

- **A** Fisher's players are national champions.
- **B** Fisher's players often become professionals.
- **C** Fisher knows that Dobbins can't play basketball.
- **D** Fisher thinks that Dobbins's scrapbook is comical.

3 What happens because Dobbins shows his scrapbook to Fisher?

A Dobbins makes the team.

B Dobbins sits in the stands.

C Dobbins drives to Atlanta.

D Dobbins plays his first game.

4 What happens to Dobbins because Michigan recruits the Fab Five?

A He joins an opposing team.

B He drives to different cities.

C He is traded to another team.

D He is dropped from the team.

5 What is the attitude of the Wolverines towards Dobbins?

A lenient

B tolerant

C admiring

D flattering

6 What word BEST describes Dobbins's character?

A critical

B humorous

C pessimistic

D determined

7 What method does the author use to dramatize the final scene of his story?

A He interviews the coach.

B He quotes two ballplayers.

C He mentions the scrapbook.

D He discusses team motivation.

8 Which set of statements BEST summarizes the story?

A Sean Dobbins wanted to score a two-point basket during his college basketball career. He scored with a free throw during his sophomore year but still wanted a two-point basket. Even though he never got to play, his teammates loved his spirit.

B Sean Dobbins dreamed of making a two-point basket during his college basketball career. Through a number of circumstances, he almost lost out on that dream. But in his senior year he finally realized his goal when he scored a basket in the final seconds of a tournament game.

C Sean Dobbins wanted to make a basket during his college basketball career. Even though he scored with a free throw, it was not good enough. He thought that he had two years left in which to score a basket. But unfortunately he had to leave the team when the Fab Five were recruited.

D Sean Dobbins was able to get on the Wolverines team by showing his high school scrapbook to the coach. He played for two seasons but had to leave the team in his junior year when the Fab Five were recruited. He never lost his enthusiasm and got a chance to play again with the team in his senior year.

Read the following story and answer Numbers 1 through 10. You may look back at the story as often as you like.

Saga of a Seagoing Dog

Condensed from SAIL PETER MUILENBURG

SANTOS, the dog that barked furiously at any hint of danger to others, made not a whimper when he slipped and fell overboard five miles off the Venezuelan coast. We didn't miss him until the morning after we had anchored our ketch,[1] *Breath,* behind the breakwater at Puerto Azul. Suddenly our son Diego called out, "Where's Santos?"

We searched everywhere. Diego even tore open our last package of tortilla chips, crackling the bag noisily and calling Santos, but the dog was gone.

My wife, Dorothy, and I went ashore to notify the port captain of our loss. The captain was busy with the start of a sport-fishing tournament. He offered us no encouragement, but promised to keep an eye out.

We walked over to the beachside bar and began to think what we would tell Diego.

TIME AND AGAIN WE had feared for Santos's life. He had been an endlessly amusing little rogue. One friend called him a hamster masquerading as a wolf, though on close inspection he looked more like a cross between fox and a pint-size husky. He was Diego's constant companion.

Santos had been given to us years ago in a Florida port where we had anchored beside a schooner with two people and seven dogs onboard. Jeanne and Vince were raising schipperkes—Belgian canal-barge dogs—and five puppies had just been born. Jeanne offered us the pick of the litter. "Your ship needs a schipperke," she declared.

I didn't think so, but my objections were blown away in a williwaw[2] of enthusiasm from the crew. I reminded the boys to pick a lively one, and they returned with a ball of jet-black fluff that looked me dead in the eye and growled.

In time Santos developed into a fine boat dog. "Schipperke" means "little captain" in Flemish, and his ancestors were bred to serve aboard Low Country[3] barges. Their duties included swimming ashore in the cold canals to nip the heels of recalcitrant[4] tow horses. And they were programmed to bark if anyone fell overboard, which made them ideal baby sitters for family-run vessels. They were even expected to help the master navigate.

Santos excelled at all these tasks, and more. One night, as a storm was brewing, we tried to gain the shelter of Mayaguana in the Bahamas. After 36 hours of overcast we couldn't be sure of our position. Suddenly Santos roused himself and stood with his nose straining into the wind, whimpering

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[1] **ketch:** a two-masted sailboat

[2] **williwaw:** a violent gust of cold wind

[3] **Low Countries:** Belgium, the Netherlands, and Luxembourg

[4] **recalcitrant:** stubborn, defiant

"Saga of a Seagoing Dog" by Peter Muilenburg, published in *Reader's Digest*'s October 1992 issue, condensed from an article from *Sail* Magazine's December 1991 issue, copyright © 1991 by Peter Muilenburg. Used by permission.

ardently. We short-tacked up the dog's olfactory bearing[5] and within two hours sighted land.

In addition, this salty dog was endearing company, especially on long night watches. Then he would creep unbidden into the lonely helmsman's lap and rest his muzzle with a sigh of contentment in one's hand.

Intelligence in a dog such as Santos can be a mixed blessing. He knew well what was expected of him, but he also had his own agenda—fun—and this got him into trouble regularly. Before he was three months old, he'd almost drowned twice. Once, charging down the deck in a puppy war game, he shot right out a deckside scupper.[6] We heard scratching on the hull and went topside to find Santos treading water. Luckily it was slack tide.

Then a month later he did it again, and the ebb tide carried him out to sea while we were lunching below. A skin diver noticed his black head and pointed ears and picked him up.

IT WAS TIME to get back to Diego; we couldn't postpone the inevitable any longer.

"Oh, well," I consoled Dorothy, "with that dog's temperament we were lucky to have him as long as we did."

We walked to the dinghy,[7] and I was casting off when we heard a shout. The port captain came hurrying down the steps from his office.

"You won't believe it," he said. "I just called the fishing boats on the radio to tally their standings for the scoreboard." He paused, out of breath.

"And?" we gasped.

"And the last boat said they caught nothing—except a little black dog!"

Back on *Breath,* Santos received a joyous welcome and got his own helping of the family dinner. But his eyes were glazed, as if they'd seen the whole of his life pass before them, and right after supper he crashed. When I drifted off later, I thought about the charmed life Santos led, and wondered whether his brush with death would make a more sensible animal of him.

That fantasy died at dawn, when a flurry of barking awoke us. A fisherman had dared to pass within 150 feet of our boat. A few hours later, seeing some kids playing with a German shepherd on the beach, Santos jumped into the sea and headed for the action. Shortly afterward someone knocked on our hull.

"Hello—is this your dog?"

"Yup," I said. "That's our dog."

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[5] **short-tacked up the dog's olfactory bearing:** steered the boat in the direction the dog was sniffing

[6] **scupper:** an opening that lets water drain out

[7] **dinghy:** a small rowboat

1 What is the tone of this story?

A nostalgic regret

B harsh irritation

C gentle amusement

D sarcastic mockery

2 When the author first met the dog, Santos seemed

A cheerful.

B miserable.

C unfriendly.

D affectionate.

3 What did Santos do when he FIRST arrived on the boat?

A He fell overboard.

B He growled at the author.

C He barked at a nearby fishing boat.

D He whimpered as he smelled the wind.

4 Why did Diego tear open the "last package of tortilla chips, crackling the bag noisily"?

A to help in the preparation of lunch

B to offer some food to the port captain

C to tempt the dog to come out of hiding

D to encourage the family to eat before leaving

5 Read the following sentence from the story.

He had been an endlessly amusing little rogue.

What does the word *rogue* mean as it is used here?

A rascal

B friend

C stranger

D monster

6 The puppy came to the family when

A Dorothy got lost in the fog off the Bahamas.

B a couple offered them their choice of a litter.

C Santos was working as a canal dog in Europe.

D a fisherman found him swimming near a fishing tournament.

7 Schipperkes helped barges navigate the canals by

A swimming alongside the barges.

B smelling the thick fog to locate land.

C alerting the captain of passengers overboard.

D encouraging tow horses to continue walking.

8 What does the author probably mean by the word *unbidden* when he writes that Santos "would creep unbidden into the lonely helmsman's lap"?

- **A** not aided
- **B** not invited
- **C** not ashamed
- **D** not observed

9 What was the author's reaction to the loss of Santos?

- **A** anger
- **B** optimism
- **C** happiness
- **D** discouragement

10 Which set of statements BEST summarizes the story?

- **A** Santos repeatedly falls or jumps overboard but is returned each time to his family's sailboat. One time he is lost off South America but is brought back by a port captain.
- **B** The author reluctantly accepts a puppy onboard his sailboat. The dog, intelligent and full of fun, endears himself to the family and has a variety of adventures on and off the boat.
- **C** *Breath*, the family sailboat, becomes the home of a happy, adventurous dog. At the end of the story, Santos jumps overboard to play on shore with another dog and some children.
- **D** A family adopts a schipperke puppy that was bred to be aboard a boat and help with navigation. As a puppy, Santos falls overboard twice; one of those times he comes back to the family with a skin diver.

Read the time line and answer Numbers 1 through 6. You may look back at the time line as often as you like.

"The History of the U.S. Postal Service" is the subject Leann Brown has chosen for a research paper. Her first job is to develop an outline, and to do that she checks her reference materials. There she finds something that helps her get started: a Postal Delivery Time Line.

POSTAL DELIVERY TIME LINE

1000 B.C.	Homing pigeons delivered King Solomon's letters to Queen of Sheba.
485–425 B.C.	Greek writer Herodotus described Persian horse postal service: "Neither snow, nor rain, nor heat, nor gloom of night stays these couriers from the swift completion of their appointed rounds."
59–44 B.C.	Julius Caesar used foot runners, then horseback riders; mail was delivered for nobility only.
A.D. 286–288	Roman Emperor Diocletian started postal service for private citizens.
1290	University of Paris began postal service for private citizens.
1591	Queen Elizabeth I established central postal service in Great Britain.
1639	First American post office set up in Boston; one cent charged for each letter.
1672	New York City began mail service to Boston, Massachusetts.
1674	Connecticut began mail service.
1683	William Penn began weekly mail service from Philadelphia to all large Pennsylvania and Maryland towns.
1693	Intercolonial postal service began in all colonies except Virginia.
1775	Benjamin Franklin was appointed first American postmaster general.
1785	Balloon carried letter addressed to Benjamin Franklin from England to France.
1799	Congress passed a death penalty for robbing the mail.
1813	First mail carried by steamboat.
1832	First official railroad mail service.
1860	Pony Express started service between St. Joseph, Missouri, and Sacramento, California.
1893	First commemorative stamps issued at Chicago World's Fair.
1896	Rural Free Delivery began.
1913	Parcel Post Delivery service started.
1918	Airmail stamps first issued.
1918	First regular airmail service in U.S.—Washington, D.C., to New York City.
1920	First transcontinental air mail service, New York to San Francisco.
1941	Post office on wheels, called Highway Post Office (HYPO), initiated.
1958	Famous artists started designing postage stamps.
1959	Transcontinental jet mail service began.
1963	Zip Code numbers put into use.

"Postal Delivery Time Line" by Betty H. Little from *Cobblestone*'s October 1981 issue: The Pony Express: 1860–1861, copyright © 1981 by Cobblestone Publishing Co., 30 Grove St., Suite C, Peterborough, NH 03458. Reprinted by permission of the publisher.

1 This time line is organized according to

- **A** when the events happened.
- **B** where the events happened.
- **C** the importance of the events.
- **D** the people involved in the events.

2 If Leann wants to make the point that mail delivery was often difficult, which fact would be BEST to include in her research paper?

- **A** In 1896, Rural Free Delivery of mail began.
- **B** In 1963, Zip Code numbers were put into use.
- **C** In 1799, Congress passed a death penalty for robbing the mail.
- **D** In 1941, a post office on wheels, called Highway Post Office (HYPO), was initiated.

3 Which phrase BEST describes the main idea of this time line?

- **A** an in-depth history of the postal service
- **B** an international tribute to the postal service
- **C** a detailed history of technological advances in the postal service
- **D** a chronological list of important events concerning the postal service

4 Which date indicates the first effect of scientific advances on the delivery of the mail?

- **A** 1639
- **B** 1813
- **C** 1832
- **D** 1918

5 What might be seen as a major trend in postal service?

- **A** speeding up the time of delivery
- **B** making stamps attractive to collectors
- **C** offering service to the common people
- **D** providing increased security for postal customers

6 When did the first mail travel by air?

- **A** in 1920
- **B** in 1918
- **C** in the 1700s
- **D** in 1000 B.C.

Read the following paragraph and list of Key Words. Answer Numbers 1 through 8. You may look back at the paragraph and list of Key Words as often as you like.

Jesse's social studies teacher assigns the class a research paper on international trade. The students must demonstrate their understanding of the topic by using terms from the following glossary. In addition, the students must provide examples of how countries buy and sell goods. Jesse learns the following terms so that he can use them correctly in his research paper.

KEY WORDS

THE TERMS OF TRADE

Here are a few key words used in international trade.

Domestic: Produced in or native to a country.

Free trade: An exchange of goods and services between countries that is not limited by government actions such as quotas, tariffs, and other taxes.

GATT (General Agreement on Tariffs and Trade): An international agreement intended to reduce trade barriers and encourage trade. GATT, established in 1947, was replaced by the WTO in 1995.

Globalization: The trend toward a single, worldwide market, without respect to national borders.

Imports/Exports

Imports: Goods and services bought from other countries for domestic use.

Exports: Goods and services produced in one country and sold to another country.

NAFTA (North American Free Trade Agreement): A 1993 agreement between Canada, the United States, and Mexico that will gradually eliminate most trade barriers between those countries.

Protectionism: Any policy designed to keep domestic industries from being hurt by competition from imports.

Protective tariff: A tax on imports designed to keep domestic producers from being hurt by competition from imports.

Quota/Tariff

Quota: A government limit on the amount of goods coming in from other countries.

Tariff: A tax on imports.

Trade barriers: Any government's use of taxes, tariffs, quotas, and other obstacles that make trade between countries more difficult or costly.

World Trade Organization (WTO): An international body that promotes free trade and resolves trade disputes between countries. The WTO was created in 1995 with the legal power to resolve a wide range of trade issues.

"The Terms of Trade" by CTB/McGraw-Hill editors

1 Jesse wants to trace the movement toward a worldwide market. He wants to include the resolution of recent trade conflicts in his research paper. Under which heading should Jesse look?

A WTO
B GATT
C Protectionism
D Trade barriers

2 Trade barriers tend to have the hardest impact on the

A country importing the products.
B people buying the imported products.
C domestic industries selling the same products.
D international organization resolving trade disputes.

3 Jesse decides to support his paper's arguments with concrete examples of countries that are putting free trade agreements into practice. Which heading should Jesse first research at the library?

A Tariffs
B NAFTA
C Globalization
D Protectionism

4 What is the BEST way for Jesse to locate countries that have recently established trade barriers?

A by gathering information from the WTO
B by researching the history of the GATT
C by discovering more facts about free trade
D by investigating the theory of globalization

5 A tax on imported products is called

A a tariff.
B a quota.
C an export.
D a trade barrier.

6 Products that are brought from another country and used domestically are called

A tariffs.
B quotas.
C exports.
D imports.

7 What is the trend toward a worldwide market that has no national boundaries called?

A free trade
B trade barriers
C globalization
D protectionism

8 Which of the following is true about NAFTA's organization?

A It is the ultimate step toward globalization of the world.

B It is a move toward using tariffs to control other countries.

C It is an example of countries working together to lower trade barriers.

D It is an example of being able to change rules in a short period of time.

Read the following brochure and answer Numbers 1 through 10. You may look back at the brochure as often as you like.

You are about to take a vacation to Pensacola with your family. You have a brochure explaining some of the things you can do while there.

PARK IT . . .

. . . **OUTDOORS.** If you'd like to experience the natural side of the Pensacola area, you're welcome to camp, hike, or fish at Gulf Islands National Seashore, a 150-mile-long strip of barrier islands, harbors, and submerged land that's one of the most beautiful and well-preserved natural environments in the country. Established in 1971—with over 25 miles located in the Pensacola and Perdido Key area—it includes Santa Rosa Island (home of historic Fort Pickens and World War II batteries), and Naval Live Oaks Reservation, a 1,400-acre tract and seashore headquarters along Highway 98 in Gulf Breeze. The Gulf Islands National Seashore also contains an extraordinary collection of wildlife—including 280 different species of birds.

To the west, you can camp, hike, or picnic at Big Lagoon State Recreation Area located near Perdido Key on the Intracoastal Waterway. Birding, boating, concerts, and special night beach tours to view the sea turtles offer something for the whole family.

For a complete change of outdoor scenery, take a hike through the shady bayou at the Edward Ball Nature Preserve on the University of West Florida campus. Or head out to Bay Bluffs Park, where several elevated boardwalks give you a bird's-eye view of Florida's only scenic bluffs—a vista 20,000 years in the making!

GO WITH THE FLOW. Not far from Pensacola you'll find an area known as "The Canoe Capital of Florida." It contains the spring-fed streams of the Coldwater, Blackwater, and Sweetwater/Juniper creeks, which flow through state forests at a tranquil, relaxing pace.

Climb aboard a canoe, kayak, paddleboat, or inner tube, and leave your cares behind as you drift down the Perdido River or through the Blackwater River State Recreation Area, northeast of Pensacola.

On shore, cabins, campsites, nature trails, and picnic areas abound—especially at Adventures Unlimited, an 88-acre park (complete with even a ropes course) that's widely regarded as the center of all the action.

"Park It" from 1995–1996 *Official Pensacola Area Visitor's Guide*, copyright © 1996 by Pensacola Chamber of Commerce
Used by permission of the Pensacola Convention & Visitor's Center

PARKS & TRAILS GUIDE Many of these items are based for the "on season" period only. For more information about seasonal changes refer to the phone numbers below this chart.	**Fort Pickens** Gulf Islands National Seashore	**Fort Barrancas** Gulf Islands National Seashore	**Naval Live Oak Reservation** Gulf Islands National Seashore	**Perdido Key Area Johnson Beach** Gulf Islands National Seashore	**Big Lagoon State Recreation Area**	**Perdido Key State Recreation Area**	**Blackwater River State Park**
Visitor's Center	○	○	○		○		
Museum	○						
Guided Tours	○	○					○
Picnic Area	○	○	○	○	○	○	○
Basic Camping	○				○		
Full Facility Camping	○				○		○
Youth Camping			○				
Cabin Rentals					○		○
Nature Trail	○	○	○		○		○
Biking	○	○	○	○	○	○	○
Swimming	○			○	○	○	○
Snorkeling	○			○	○		
Lifeguard	○			○			
Canoeing					○		○
Fishing	○			○	○		
Boat Ramp				○	○		○
Restrooms	○	○	○	○	○	○	○
Showers	○			○	○		
Concessions	○			○			
Handicap Access	○	○	○	○	○	○	○
Parking	○	○	○	○	○	○	○
Park Fee	○			○	○	○	○

Gulf Islands National Seashore 904-934-2600: *Fort Pickens, Fort Barrancas, Naval Live Oak Reservation, Perdido Key Area Johnson Beach*

Perdido Key State Recreation Area 904-492-1595

Big Lagoon State Recreation Area 904-492-1595

Blackwater River State Park 904-623-2363

"Trail Mix" from 1995–1996 *Official Pensacola Area Visitor's Guide*, copyright © 1996 by Pensacola Chamber of Commerce. Used by permission of the Pensacola Convention & Visitor's Center.

1 According to the chart, if campers want information about seasonal changes at a specific park or beach, they should telephone

A their travel agency.

B a historical society.

C that recreation area.

D the brochure publishers.

2 Campers who call one of the phone numbers below the Parks and Trails Guide are most likely seeking information about what kind of activities?

A winter

B summer

C on season

D off season

3 Which action shows that the chart was interpreted correctly?

A traveling to Fort Barrancas for fishing

B going to Naval Live Oak Reservation to rent a cabin

C hauling a boat to Perdido Key State Recreation Area

D arriving at Big Lagoon State Recreation Area with canoes

4 Which place has elevated boardwalks?

A Bay Bluffs Park

B Intracoastal Waterway

C Blackwater River State Park

D Big Lagoon State Recreation Area

5 In which park can you see sea turtles at night?

A Naval Live Oak Reservation

B Edward Ball Nature Preserve

C Big Lagoon State Recreation Area

D Perdido Key State Recreation Area

6 Where is Naval Live Oak Reservation?

A next to the Perdido Key area

B along Highway 98 in Gulf Breeze

C next to Gulf Islands National Seashore

D by Santa Rosa Island just outside of Pensacola

7 Which park has shower facilities?

A Fort Barrancas

B Naval Live Oak Reservation

C Blackwater River State Park

D Perdido Key Area Johnson Beach

8 How are the first and second parts of this brochure different?

A The first part promotes the features of parks; the second part lists factual information.

B The first part lists sequential details; the second part promotes the highlights of parks.

C The first part lists details; the second part contains chronological information about parks.

D The first part contains chronological information about parks; the second part describes various features.

9 How does the author support the statement that the Pensacola area is "one of the most beautiful and well-preserved natural environments in the country"?

A by listing recreational activities

B by naming state recreation areas

C by describing the scenery and wildlife

D by outlining the geographic boundaries

10 Why is an area near Pensacola referred to as "The Canoe Capital of Florida"?

A It has a long coastline.

B It is situated in a quiet harbor.

C It has many slow-moving streams.

D It is situated in the state forest system.

Read the following article and answer Numbers 1 through 7. You may look back at the article as often as you like.

SUSAN G. McBRIDE

VIDEO GAME DESIGNER

San Jose, California

WHAT I DO:

I come up with ideas for home computer video games, figure out how they would be played, and determine their basic graphic look. Then, I work with a team to fill out these designs. Right now my team includes another animator and a programmer, but we also get help from graphics, audio, and software support personnel. When I used to work on coin-operated arcade games, I worked on teams with two or three other programmers and up to five animators.

After getting an idea for a game, you produce story boards and thumbnail sketches that show how the new game will look. Then, once the concept is approved, you work out all the characters and the opponents, what the moment-to-moment action will be like, and how the controls will work. This stage includes producing working graphics and a model of the controls. When all that's finished, the concept is reviewed again and focus groups are held to estimate consumer reaction. Finally, the game is field tested.

Home games are different from coin-operated games. In coin-op games, you're trying to entice people to put their quarters into a machine. You know they're not going to play for long. But with home games, people own the cartridges, so you know they'll want to play the games for a long time. As a result, home games need to be more exploratory and graphically exciting. They're better suited to adventure formats than coin-op games.

HOW I GOT STARTED:

I came to this work by way of drawing. When I was a kid, I was always drawing. I drew my own comic books and illustrated T-shirts. In college, I almost double majored in graphic design and science. But I realized that what I really liked the most about biology was drawing the animals we worked with. So I decided to major exclusively in graphic design.

Graphic design led me in turn to animation and film. A film teacher of mine recommended me to Atari for a position involving computer graphics. He knew about the little characters I liked to animate and about an award-winning film that I made called *Mangia, Mangia, Mangia*. Done before Pac Man, it was about a little space creature that went around gobbling things up. I guess that my professor—and Atari—thought the film proved I was a natural for creating video games and characters.

HOW I FEEL ABOUT IT:

What I really like about working in the game industry is the chance to be creative and to come up with concepts that provide fun and entertainment for people. The games take people away from the world for a little while.

Each game is like a new beginning. You're creating a new world, and it's a thrill when it comes together. When you come up with an idea you love, you suddenly know it's going to be a hit, and that's very exciting.

"Video Game Designer" by Susan G. McBride from *Careers for Computer Buffs* by Andrew Kaplan, copyright © 1991 by The Millbrook Press. Used by permission.

WHAT YOU SHOULD KNOW:

There are a number of different routes into this business. You can come in as a programmer or, as I did, through animation. But even if your route is animation, you still need to get as much of a background in computers as you can.

To break in, you need to have a degree. Animators need to have a strong film background with a degree in something like film, animation, or art. Programmers need computer degrees. And after you're in, it's still a good idea to keep learning. Game designers need to have as much computer knowledge as they can. For example, although I'm already established in the industry, I'm getting additional software background and working toward a master's degree.

The pay varies. Some people get royalties, which can double or triple their salaries.

Another way to go is to open up your own house. Get an animator, a designer, a programmer, an engineer, and an audio person. Then develop games, sell them to companies, and get royalties. This arrangement offers you the potential to earn a lot of money.

To create these games, you need to enjoy children's culture and know what's going on with kids. Obviously, it helps to know what kids like to watch and the music they like to listen to. I go to science fiction conventions, arcades, and movies to keep up, and I also buy comic books and kids' magazines.

1 Information in the article is organized according to

A isolated blocks of information.

B separate sections with headings.

C steps explaining how to enter the field.

D important events in the author's career.

2 The author's main purpose in this article is to

A inspire.

B inform.

C entertain.

D persuade.

3 The next step after approval of a game concept is to

A field test the game.

B produce story boards.

C create a working model.

D estimate consumer reaction.

4 What convinced Atari of the author's creative abilities?

A her early drawings

B her job application

C her scientific sketches

D her award-winning film

5 When the author says, “Another way to go is to open up your own house,” she is comparing a working group to a

A team.

B family.

C school.

D neighborhood.

6 If the next subheading in this article were “WHERE WE'RE HEADED,” which of the following subjects would most likely be covered in that paragraph?

A the reader's future needs

B the future of children's culture

C the author's plans for the future

D the future of video game design

7 Which set of statements BEST summarizes the author's advice for entering and working in the video game design business?

A Obtain a master's degree in computers and open your own design house. Develop your own games and then sell them to other companies.

B Pursue a double major in art and computers and form a team of developers. Sell your games to software companies and collect royalties.

C Major in animation and find a job that will teach you how to use computers. Improve your skills by taking night classes and attending children's cultural events.

D Obtain a degree in an art-related field and learn as much as you can about computers. Continue to improve your skills and keep in touch with what kids are doing.

Read the following article and answer Numbers 1 through 9. You may look back at the article as often as you like.

DON SMALL

FLIGHT SIMULATOR

Houston, Texas

WHAT I DO:

Because I've been designing flight simulators for more than thirty-five years, I've worked on everything from airplane simulators to machines that simulate space flight. Right now, I'm working on a simulator for a space station.

To understand my work, you have to understand what a flight simulator is. A simulator's function is to prepare pilots, crew members, and astronauts for flight. When we design a simulator, we create a machine that will replicate[1] the trainee's future environment as closely as possible. The trainee uses the same controls found in the actual vehicle.

HOW I GOT STARTED:

I didn't start by pursuing a career in flight simulation. When I went to college, I began as a pre-med student. But I didn't like that side of science, so I moved into electronics.

After college, I got a job with a flight simulation company called Link. Link was just switching over from mechanical air trainers to electronic trainers, and they were recruiting electronics people like myself. I started as a field engineer, working in the factory to gain an understanding of the equipment. Then I went to the customers, trained them to use the equipment, and made any modifications that were necessary.

After that, I became involved with the space program. I worked on the Gemini mission simulator and other space flight simulators until 1969, when I moved to Houston to work with NASA on the Apollo program. After Apollo ended, I headed teams that built the simulator for the space shuttle.

HOW I FEEL ABOUT IT:

What's challenging about this work is that it explores every branch of science there is. We have to model the behavior of the real world so that what a person feels is exactly coordinated with what he or she hears and sees. That means really getting into a person's senses. To do this, you need a variety of engineering skills, and you must constantly call on all of your training and experience.

WHAT YOU SHOULD KNOW:

Today, most of the people we hire have computer science, electrical engineering, or physics degrees. Some even have simulation-related degrees. But even if you get one of these degrees, you still have to be trained as a systems engineer by Link or one of its competitors.

Normally, this is a regular eight-to-five job. However, there are times when you'll be working over sixty hours a week. This tends to occur either in the development cycle when things don't go as planned, or later during the space mission itself when something that wasn't anticipated happens. When I was working on Apollo 13, for example, one of the ship's tanks exploded on the way to the moon. I was part of a team that helped figure out a way to get the crew back before its supplies were exhausted. On that mission, I worked for thirty-six hours straight.

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[1] **replicate:** to duplicate or copy

"Flight Simulator" by Don Small from *Careers for Computer Buffs* by Andrew Kaplan, copyright © 1991 by The Millbrook Press
Used by permission.

1 A simulator for a space station is probably used to

A study conditions in space.

B launch the space shuttle into orbit.

C form a satellite link among nations.

D prepare astronauts for living in space.

2 What field of knowledge is MOST important for a flight simulation designer?

A graphics

B aeronautics

C psychology

D engineering

3 What makes a simulator different from other training methods?

A It reproduces actual conditions.

B It is used only for flight training.

C It is designed by professional trainers.

D It allows people to perform their jobs right away.

4 In the section titled "HOW I GOT STARTED," information is organized by

A date.

B skill.

C time.

D importance.

5 The author's experience with the flight simulation company probably

A prepared him to be a pilot.

B led him to pursue a degree in electronics.

C taught him a lot about the Apollo program.

D helped him get a position with the space program.

6 What does the author mean by "getting into a person's senses"?

A studying the physical effects of stress

B measuring the intelligence of humans

C controlling a person's thoughts and feelings

D understanding what a person is seeing and hearing

7 What is one of the common causes of long work hours in this field?

A unscheduled space launches

B team meetings to discuss future projects

C unexpected events during space missions

D special training to prepare new employees

8 The BEST way to prepare for a career in flight simulation design is to

A learn how to fly and train others.

B major in psychology or sociology.

C pursue a degree in engineering or science.

D receive on-the-job training in systems engineering.

9 Which statement BEST expresses the main idea of this article?

A This is a demanding job that requires intense preparation and training.

B This is an exciting job for people who like to work with others and make important decisions.

C This is a good job for people who like an eight-to-five schedule with few interruptions and little stress.

D This is a challenging job that calls upon all of your training and experience in a variety of scientific fields.

Read the following article and answer Numbers 1 through 9. You may look back at the article as often as you like.

Pollution's Hidden Toll on Native Plants

Nitrogen is an important plant nutrient, right? So when your car spews out nitrogen emissions into the environment and they settle onto the ground, are you enhancing plant growth? The answer may be yes, but, scientists are discovering, it's not the kind of growth that benefits native plants.

For 12 years, ecologists David A. Wedin of the University of Toronto and David Tilman of the University of Minnesota have applied nitrogen to 162 plots of native grasses at levels that approximate the amount of nitrogen that occurs in air-borne pollution from cars and power plants in the Northeast. Though plants need nitrogen to grow, the researchers found that the elevated nitrogen levels stimulated the growth of grasses imported from Europe while impairing the growth of native grasses.

This unusual situation apparently results from the way the two groups of plants use nutrients. Native grasses thrive in areas of relatively low nitrogen, while European interlopers imported for agricultural development need large doses of the nutrient. Once nitrogen increases in the soil, as when motor-vehicle pollution settles to the ground, non-native plants take over. Subsequent changes in the soil also increase nitrogen pollution in water supplies. In addition, species diversity in affected areas declines.

The news represents another blow to the nation's grasslands, which have declined considerably. What's more, observes Wedin, the disruptions caused by air-borne nitrogen may not be restricted only to grasslands, since the same effect is likely in other plant communities.

1 What is one important fact that researchers have found out about native grass plants?

A They require less attention.

B They require more nutrients.

C They require low levels of nitrogen.

D They require regular supplies of water.

2 How are increased levels of nitrogen beneficial?

A They enrich native plants.

B They stimulate imported grasses.

C They are good for water supplies.

D They are helpful for species diversity.

3 What is the meaning of the word *enhancing* as it is used in the first paragraph?

A creating

B decreasing

C stimulating

D illuminating

4 What effect does an increased level of nitrogen have on non-native grasses?

A It blocks nutrients.

B It stimulates growth.

C It activates diversity.

D It inhibits development.

"Pollution's Hidden Toll on Native Plants" from *National Wildlife*'s April/May 1997 issue, copyright © 1997 by National Wildlife Federation. Used by permission.

5 What is the meaning of the word *interlopers* as used in the third paragraph?

A visitors

B invaders

C achievers

D impostors

6 Read this sentence.

Though plants need nitrogen to grow, the researchers found that the elevated nitrogen levels stimulated the growth of grasses imported from Europe while impairing the growth of native grasses.

What is the meaning of the word *impairing* as it is used here?

A hastening

B damaging

C increasing

D disintegrating

7 How does a raised level of nitrogen in the soil affect the water supply?

A It increases pollution.

B It encourages oxygen.

C It activates organisms.

D It introduces nutrients.

8 Which idea from the article is not supported by evidence?

A Air-borne nitrogen is likely to disrupt other plant communities.

B Wedin and Tilman studied the effects of applied nitrogen for more than ten years.

C Air-borne nitrogen pollution from cars and power plants was approximated in a study.

D Changes in the amount of nitrogen in the soil change the amount of nitrogen in water supplies.

9 Which statement BEST summarizes the article?

A Scientists have discovered that when nitrogen levels in the soil increase, water supplies can become contaminated.

B Ecologists have discovered that air-borne nitrogen disrupts grassland growth and can affect plant communities in diverse areas.

C Ecologists have discovered that high levels of nitrogen cause non-native plants to grow while restricting the growth of native plants.

D Scientists have discovered that increased levels of nitrogen stimulate the growth of non-native plants but they also poison the water supply.

Read the following editorial and answer Numbers 1 through 11. You may look back at the editorial as often as you like.

Point of View on Advertising

by Andrew McFarland

Economists tell us that a healthy economy depends upon a healthy flow of goods and services. When people stop buying and selling, the economy goes into a tailspin. People become poor, and life becomes a barren struggle for survival at the subsistence level.

Someone who wants to sell something has to let people know what it is and how much it costs. A seller has to show wares and convince people that they need them. In other words, a seller has to advertise.

It has become fashionable recently to belabor advertising as a sinister plot to swindle the consumer and litter the countryside with huge piles of junk. Eye-catching, multicolored advertisements in slick magazines, as well as amusing commercials on TV, are decried as being not only insulting to the intelligence of the adult, but also, what's worse, damaging to the minds of children. Yet without them, both magazine publishers and television stations would go bankrupt, because advertisers contribute a major part of their revenue.

Another charge frequently made against the advertising industry is that advertising causes people to buy what they don't need or want. An unusual assertion indeed in a liberal democracy founded on the principle of free choice! This charge conjures up visions of a helpless citizenry enmeshed in a brainwashing mechanism. Search as you may, you will never find in American court records a single case of an innocent citizen being forced by advertisers or advertising into buying something he or she didn't want. Yes, *caveat emptor!* (let the buyer beware), but don't eliminate the sales pitch just because some people have bad judgment. Reflect for a moment on what this country would be today if it weren't for advertising.

Still other critics say that advertising contributes to pollution and is hastening the depletion of our raw materials. Because advertising is partly responsible for the flow of goods and services, this assertion may be true. But several other agents also contribute: the consumer who wants the goods, the manufacturer who profits by their production, the stockholder who wants a cut, the government that needs the tax money produced by the economy, and so on. Look back over this list and see where you fit in!

Next time you hear someone say that advertising has an adverse effect on the nation, remember that it is the catalyst in the essential buying-selling process.

"Point of View on Advertising" by CTB/McGraw-Hill editors

1 How is this editorial organized?

A main idea supported by statistical examples

B critical ideas contradicted by logical statements

C a number of topics introduced for further development

D a number of topics considered, all of historical significance

2 Which technique does the author use to strengthen his argument about advertising?

A using personal testimonies

B giving statistics to show effectiveness

C addressing both positive and negative aspects

D describing advertisements that were successful

3 What method does the author use to convince the reader of his viewpoint?

A citing statistics

B quoting experts

C frightening the reader

D contradicting the critics

4 Which of the following ideas from the editorial is an example of faulty logic?

A To let people know what is for sale, sellers have to advertise.

B Without amusing commercials on TV, television stations would go bankrupt.

C You cannot take a company to court for selling something a buyer doesn't need.

D Manufacturers often contribute to pollution and hasten the depletion of our raw materials.

5 Read the following statement from the editorial.

Search as you may, you will never find in American court records a single case of an innocent citizen being forced by advertisers or advertising into buying something he or she didn't want.

Which phrase is used by the author to avoid a serious flaw in logic?

A "Search as you may"

B "an innocent citizen"

C "into buying something"

D "in American court records"

6 Which of the following ideas from the editorial is a FACT?

A Manufacturers profit by the production of goods.

B Most advertising is designed to brainwash people.

C Someone who wants to sell something must advertise.

D Television commercials damage the minds of children.

7 Which of the following ideas from the editorial is an OPINION?

A Advertising affects the flow of goods and services.

B Some magazines contain multicolored advertisements.

C Advertising causes consumers to buy items they do not need.

D Commercial television stations depend on advertising for revenue.

8 Read the following sentence.

Another charge frequently made against the advertising industry is that advertising causes people to buy what they don't need or want. An unusual assertion indeed . . .

What does the word *assertion* mean as used here?

A denial

B question

C statement

D predicament

9 According to the editorial, what would happen without advertising?

A Citizens would become wiser consumers.

B Farming would dominate economic decisions.

C Pollution and depletion of natural resources would increase.

D Exchange of goods and services would be drastically reduced.

10 Which of the following most accurately states the point of view of the author?

A Advertising contributes to pollution.

B Advertising is insulting to an intelligent adult.

C Advertising is an essential component of a healthy economy.

D Advertising causes people to buy things they don't want or need.

11 Advertising could hasten the depletion of raw materials by

A lowering environmental protection.

B causing inefficient production methods.

C generating over-consumption of products.

D providing excess profits to manufacturers.

Read the following article and answer Numbers 1 through 8. You may look back at the article as often as you like.

From Points to

Periods

(& commas, colons, dashes, ellipses, etc.):

by Pico Iyer

A Punctuation History

Imagine a world without commas or question marks. If that sounds great to you, you may wish you lived centuries ago, because punctuation as we know it today didn't always exist.

Greeks and Romans Get the Point

Both the Greeks and the Romans wrote without any separations between words; their inscriptions flowed in long, unbroken streams. The Latin word *punctus*, from which our word *punctuation* derives, simply means "point." And the first punctuation marks were just that—points placed between words in Greek and Latin texts to separate them. Later points were placed at different heights next to words to indicate places to pause or stop. The points didn't end sentences, or set off clauses, they simply gave some aid in reading aloud.

In fact, for centuries punctuation wasn't used to clarify grammar at all. It was used only to help people who were reading aloud figure out where to raise their voices, and where to slow down. The marks had nothing to do with meaning (so you were on your own if you needed to know a question from an exclamation).

Punctuation Heats Up

But things changed. In the 10th century, people started to write Latin with spaces between the words. An extra space at the end of a sentence became the rule, and a bigger letter was used at the beginnings of sentences and paragraphs. Parentheses showed up around 1500, and commas, periods, and semicolons were in use in Latin texts by the end of the 16th century.

By the end of the 17th century writers of English were using most of the marks of punctuation we're used to. However, the purpose of punctuation was still elocutionary, not syntactical.[1] The poet Ben Jonson was the first to recommend that punctuation marks be used to help readers figure out the meaning of a sentence, and not just how to recite it.

By the 18th century, writers of English had gone a little wild with punctuation, using commas to separate everything. It was Henry Watson Fowler and Francis George Fowler in *The King's English* (1906), who advocated easing up a bit. Our rules for correct punctuation still follow the guidelines that the Fowlers laid down.

Modern Rebels: Tom Wolfe and e.e. cummings

If, as the writer Pico Iyer states, punctuation has now become "a pillar that holds society upright," then an author's violation of the rules of punctuation can be a kind of rebellion. That does not mean that a writer ignores the rules, or makes unintentional mistakes. Instead, he or she both uses *and* breaks the rules to express meaning that can't be expressed in any other way. Poet e.e. cummings and journalist and novelist Tom Wolfe are two of the many writers whose work challenges the authority of the rules.

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[1] **syntactical:** of or relating to the rules for forming grammatical sentences

Adaptation of "From Points to Periods" from *Literary Cavalcade* Magazine's January 1997 issue, copyright © 1997 by Scholastic, Inc. Used by permission

1 What is the author's purpose in writing this article?

- **A** to promote the use of punctuation
- **B** to explain the history of punctuation
- **C** to demonstrate the rules of punctuation
- **D** to illustrate the necessity of punctuation

2 How is the information in this article organized?

- **A** events presented in the order they occurred
- **B** general statements clarified by specific examples
- **C** overall descriptions followed by detailed analyses
- **D** definitions supported through references to authorities

3 In the development of punctuation, which appeared FIRST?

- **A** points
- **B** spaces
- **C** ellipses
- **D** semicolons

4 Read the following sentences from the article.

However, the purpose of punctuation was still elocutionary, not syntactical. The poet Ben Jonson was the first to recommend that punctuation marks be used to help readers figure out the meaning of a sentence, and not just how to recite it.

What is the meaning of *elocutionary* as it is used here?

- **A** related to speaking publicly
- **B** related to memorizing words
- **C** related to arranging sentences
- **D** related to understanding word meanings

5 Read the following sentence from the last paragraph under **"Punctuation Heats Up."**

It was Henry Watson Fowler and Francis George Fowler . . . who advocated easing up a bit.

What is the meaning of the word *advocated* as it is used in this paragraph?

- **A** required
- **B** continued
- **C** discovered
- **D** recommended

6 What is the central thought of the section entitled **"Modern Rebels: Tom Wolfe and e.e. cummings"**?

A Writer Pico Iyer is a rebel who violated punctuation rules.

B Writers today mold punctuation to express themselves individually.

C Tom Wolfe and e.e. cummings have many punctuation mistakes in their works.

D The importance of punctuation in contemporary society should not be overlooked.

7 If the next subheading in the article were **"The Electronic Age,"** which of the following questions would most likely be answered in the paragraph?

A Has punctuation advanced the electronic revolution?

B Will the rules of punctuation change in the computer era?

C Has punctuation been made obsolete by the electronic age?

D Will computer software adjust to punctuation requirements?

8 Which set of statements BEST summarizes the article?

A Punctuation has evolved throughout history. The guidelines and rules we now use were introduced by the 18th century; however, some modern writers have been known to change the rules to fit their individual needs.

B Punctuation has changed very little from the days of the Greeks and Romans. Some of the same punctuation marks and guidelines used in the 16th century are still used today, causing some contemporary authors to challenge existing rules.

C The purpose of punctuation has remained constant although the punctuation marks themselves have changed. Therefore, some 20th century writers agree that to ignore these rules may be considered a type of rebellion against society.

D Punctuation was introduced to the world by the Greeks and the Romans. Until the 17th century the purpose of punctuation was not to clarify grammar, but to aid people in reading aloud. As the purpose of punctuation changed, so have the rules, and very few rules currently remain.

Read the following article and answer Numbers 1 through 5. You may look back at the article as often as you like.

The Globe Theater

THE GLOBE THEATER, a playhouse originally constructed in 1599 across the Thames River from London, England, has been rebuilt a second time. The reconstructed theater was opened officially in 1997.

The Globe, perhaps the most famous theater in history, was the scene of William Shakespeare's major plays, and two of his works about English kings bracketed its early years. The first, *Henry V*, christened the new theater; the second, *Henry VIII*, was playing in 1613 when a cannon, discharged at the entry of the king, set the thatched roof afire and completely destroyed the building. It was rebuilt in a year, but again tragically razed in 1644.

It was in the opening chorus of *Henry V* that Shakespeare referred to the theater as "this wooden O." His pride was justified, since he had been made a part owner of the building.

The original Globe was constructed by a syndicate headed by the Burbage brothers, Cuthbert and Richard. To build it, they tore down their previous playhouse, "The Theater," and transported the timber to the new site on carts. Luckily, it was an extremely cold winter, so the workmen were able to haul the material across the Thames, rather than using the crowded London Bridge.

The stage itself was ideally suited to the intimate, swiftly moving style of Elizabethan drama. The jutting forestage was used for general action. Behind it, there was a curtained-off area that could become a bedroom, as in *Othello*, or a cave, as in *The Tempest*. Above that was a gallery that was ideal for balcony scenes, and over that a smaller gallery for musicians. Above all was a false ceiling, known as "the Heavens." Permanent doors gave access on either side of the main stage; trap doors allowed for sudden appearances and disappearances.

The general audience, known as "groundlings," stood in the unroofed "yard" of the theater to watch the plays. A rough and rowdy bunch, they loved ghosts, sword fights, and amusing wordplay. Around them, in the galleries, the wealthier customers sat. The courtiers and gallants, for a higher price, were allowed to sit on the stage itself.

Rebuilding the famous playhouse was the dream of American actor Sam Wanamaker. In London, just after World War II, he tried to find the site of the theater and could locate nothing more than a metal plaque on a decrepit brewery. He spent the next 40 years finding the money and organizing the reconstruction of an exact replica of the old Globe, just a few yards from its original location. Now, tourists visiting London can put themselves in the shoes of those Elizabethan playgoers who cheered and jeered from the yard and galleries of the "wooden O."

1 Workmen were able to haul materials across the Thames River because

A it was frozen over.

B London Bridge had been built.

C they had specialized equipment.

D it was less crowded than London Bridge.

2 What is apparent from the seating arrangements at the Globe?

A There was one ticket price for all.

B The audience appreciated fine music.

C Trap doors allowed for dramatic entrances.

D There were distinctions among social classes.

"The Globe Theater" by CTB/McGraw-Hill editors.

3 What is the main idea of this article?

A The Globe Theater has a long history.

B The Globe Theater is now a tourist attraction.

C The Globe Theater has recently been rebuilt.

D The Globe Theater is currently owned by a syndicate.

4 What caused the Globe Theater to burn down?

A a cannon shot

B a rowdy patron

C the king's entry

D the wooden stage

5 Which set of statements BEST summarizes the article?

A The Globe is the most famous theater in history because Shakespeare's plays were performed there. It burned down and then was rebuilt a year later.

B The Globe's design made it the ideal theater for Shakespeare's plays. For this reason, it was reconstructed after many years and despite difficult problems.

C The Globe was originally constructed by the Burbage brothers on the site of an earlier playhouse. After years as the site of Shakespeare's plays, it was razed and then rebuilt.

D The Globe, where Shakespeare's plays were first performed, is possibly the most famous theater in history. A rebuilt version of it was opened in London after a period of reconstruction.

Read the following paragraph and bus schedule and answer Numbers 1 through 8. You may look back at the paragraph and bus schedule as often as you like.

Timothy is planning to take a bus trip over the winter break. He will be leaving from Mobile. He is looking at the schedule below to help him plan his trip.

BUSES LEAVING MOBILE

Destination	Bus Number	Departs	Arrives	Stops
Chattanooga, TN	46	9:45 a.m.	6:10 p.m.	None (EXPRESS)
Dalton, GA	498	10:01 a.m.	9:00 p.m.	Montgomery, AL
Glasgow, KY	73	10:15 a.m.	1:15 p.m.	None (EXPRESS)
Lexington, KY	575	12:30 p.m.	7:00 a.m.	Tuscaloosa, AL Chattanooga, TN
Carbondale, IL	109	3:25 p.m.	2:00 p.m.	Madisonville, KY

1 What is the number of the bus that will make the most stops before reaching its final destination?

A 46

B 498

C 575

D 109

2 What is the number of the bus that stops in Montgomery, Alabama, before it reaches its final destination?

A 498

B 73

C 575

D 109

3 To which of the following cities is there a nonstop bus from Mobile?

A Dalton, GA

B Glasgow, KY

C Lexington, KY

D Carbondale, IL

4 What can you determine about the buses labeled "EXPRESS"?

A These buses drive faster.

B These buses don't cost as much.

C These buses carry more passengers.

D These buses don't make any stops.

Paragraph and bus schedule by CTB/McGraw-Hill editors.

5 What time does the bus to Carbondale, IL, leave Mobile?

A 10:01 a.m.

B 10:15 a.m.

C 12:30 p.m.

D 3:25 p.m.

6 A friend asks Timothy which bus to take to travel from Mobile to Montgomery. What is the number of the bus he should take?

A 46

B 498

C 73

D 109

7 The information in the bus schedule is organized by

A bus numbers numerically ordered.

B transfer places ordered by distance.

C destinations alphabetically ordered.

D departure times chronologically ordered.

8 The bus schedule presents information in

A related blocks of places and times.

B separate columns with headings.

C steps telling how to buy a ticket.

D interesting sites to see en route.

ITEMS

BY

STANDARD AND OBJECTIVE

STANDARD I: The student will demonstrate literal understanding of passages taken from textual, functional, and recreational reading material.

OBJECTIVE

1. Identify supporting details.

ELIGIBLE CONTENT

- Identify details that support main idea(s) in one or more passages.

SAMPLE ITEMS

The item below references "Just Two Points Make One Dream Come True" on page 12.

1 Why does Fisher think it is funny when Dobbins wants to join the Wolverines?

* **A** Fisher's players are national champions.
B Fisher's players often become professionals.
C Fisher knows that Dobbins can't play basketball.
D Fisher thinks that Dobbins's scrapbook is comical.

The item below references "Park It" on page 24.

2 Which place has elevated boardwalks?

* **A** Bay Bluffs Park
B Intracoastal Waterway
C Blackwater River State Park
D Big Lagoon State Recreation Area

The item below references "Park It" on page 24.

3 In which park can you see sea turtles at night?

A Naval Live Oak Reservation
B Edward Ball Nature Preserve
* **C** Big Lagoon State Recreation Area
D Perdido Key State Recreation Area

The item below references "Park It" on page 24.

4 Where is Naval Live Oak Reservation?

A next to the Perdido Key area
* **B** along Highway 98 in Gulf Breeze
C next to Gulf Islands National Seashore
D by Santa Rosa Island just outside of Pensacola

The item below references "The Globe Theater" on page 42.

5 What caused the Globe Theater to burn down?

* **A** a cannon shot

B a rowdy patron

C the king's entry

D the wooden stage

The item below references "Flight Simulator" on page 31.

6 The BEST way to prepare for a career in flight simulation design is to

A learn how to fly and train others.

B major in psychology or sociology.

* **C** pursue a degree in engineering or science.

D receive on-the-job training in systems engineering.

The item below references "Flight Simulator" on page 31.

7 What field of knowledge is MOST important for a flight simulation designer?

A graphics

B aeronautics

C psychology

* **D** engineering

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

8 How are increased levels of nitrogen beneficial?

A They enrich native plants.

* **B** They stimulate imported grasses.

C They are good for water supplies.

D They are helpful for species diversity.

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

9 What is one important fact that researchers have found out about native grass plants?

A They require less attention.

B They require more nutrients.

* **C** They require low levels of nitrogen.

D They require regular supplies of water.

The item below references "Postal Delivery Time Line" on page 19.

10 When did the first mail travel by air?

A in 1920

B in 1918

C in the 1700s

* **D** in 1000 B.C.

The item below references "Saga of a Seagoing Dog" on page 15.

11 What was the author's reaction to the loss of Santos?

A anger

B optimism

C happiness

* **D** discouragement

The item below references "Saga of a Seagoing Dog" on page 15.

12 The puppy came to the family when

A Dorothy got lost in the fog off the Bahamas.

* **B** a couple offered them their choice of a litter.

C Santos was working as a canal dog in Europe.

D a fisherman found him swimming near a fishing tournament.

The item below references "The Terms of Trade" on page 21.

13 Which of the following is true about NAFTA's organization?

A It is the ultimate step toward globalization of the world.

B It is a move toward using tariffs to control other countries.

* **C** It is an example of countries working together to lower trade barriers.

D It is an example of being able to change rules in a short period of time.

The item below references "Dorothy Parker" on page 7.

14 When Dorothy Parker wrote, "Dear God, please make me stop writing like a woman," she meant she would rather write

A with a masculine style.

B without using her wit.

C about something she knows.

* **D** about something other than romantic love.

STANDARD I: The student will demonstrate literal understanding of passages taken from textual, functional, and recreational reading material.

OBJECTIVE

2. Determine sequence of events.

ELIGIBLE CONTENT

- Identify sequential order in one or more passages. (Note: Sequential order may include dates; first, next, last; before and after; and order of events.)

SAMPLE ITEMS

The item below references "Dorothy Parker" on page 7.

1 How did Dorothy Parker begin her career as a writer?

* **A** as a copywriter for *Vogue*

B as a student at convent school

C as a drama critic for *Vanity Fair*

D as a member of the Algonquin Round Table

The item below references "In and of Ourselves We Trust" on page 10.

2 When does Andy Rooney decide that he stopped at the red light "because it's part of a contract we all have with each other"?

* **A** after he goes to bed

B while braking for the light

C during his wait at the light

D before he reaches Lewisburg

The item below references "Saga of a Seagoing Dog" on page 15.

3 What did Santos do when he FIRST arrived on the boat?

A He fell overboard.

* **B** He growled at the author.

C He barked at a nearby fishing boat.

D He whimpered as he smelled the wind.

The item below references "From Points to Periods" on page 39.

4 In the development of punctuation, which appeared FIRST?

* **A** points

B spaces

C ellipses

D semicolons

The item below references "Video Game Designer" on page 28.

5 The next step after approval of a game concept is to

A field test the game.

B produce story boards.

* C create a working model.

D estimate consumer reaction.

STANDARD I: The student will demonstrate literal understanding of passages taken from textual, functional, and recreational reading material.

OBJECTIVE

3. Follow directions.

ELIGIBLE CONTENT

- Identify directions that are implicit or embedded in a passage.
- Identify the outcome or product of a set of directions.
- Recognize when a set of directions has been followed correctly.

Note: Directions will relate to activities that are appropriate for Grade 11 students.

SAMPLE ITEMS

The item below references "Park It" on page 24.

1 According to the chart, if campers want information about seasonal changes at a specific park or beach, they should telephone

A their travel agency.

B a historical society.

* **C** that recreation area.

D the brochure publishers.

The item below references "Park It" on page 24.

2 Campers who call one of the phone numbers below the Parks and Trails Guide are most likely seeking information about what kind of activities?

A winter

B summer

C on season

* **D** off season

The item below references "Park It" on page 24.

3 Which action shows that the chart was interpreted correctly?

A traveling to Fort Barrancas for fishing

B going to Naval Live Oak Reservation to rent a cabin

C hauling a boat to Perdido Key State Recreation Area

* **D** arriving at Big Lagoon State Recreation Area with canoes

STANDARD II: The student will interpret passages taken from textual, functional, and recreational reading material.

OBJECTIVE

1. Identify main idea.

ELIGIBLE CONTENT

- Recognize the main idea in a paragraph or passage(s). (Note: Main idea may include topic, subject, theme, central thought or message, lesson or moral, thesis, and author's purpose and/or point of view.)

SAMPLE ITEMS

The item below references "The Globe Theater" on page 42.

1 What is the main idea of this article?

* **A** The Globe Theater has a long history.

B The Globe Theater is now a tourist attraction.

C The Globe Theater has recently been rebuilt.

D The Globe Theater is currently owned by a syndicate.

The item below references "Flight Simulator" on page 31.

2 Which statement BEST expresses the main idea of this article?

A This is a demanding job that requires intense preparation and training.

B This is an exciting job for people who like to work with others and make important decisions.

C This is a good job for people who like an eight-to-five schedule with few interruptions and little stress.

* **D** This is a challenging job that calls upon all of your training and experience in a variety of scientific fields.

The item below references "Just Two Points Make One Dream Come True" on page 12.

3 What is a major theme in this story?

* **A** It takes commitment to reach a goal.

B It takes conviction to sit on the bench.

C It takes persistence to get an education.

D It takes concentration to make a basket.

The item below references "In and of Ourselves We Trust" on page 10.

4 What is the main idea of this newspaper column?

* **A** We must trust each other in order to have a stable society.

B We stop at red lights because we obey social conventions.

C We should pay our taxes even when we don't agree with the government.

D We tell others about our honesty so they will be more likely to follow the rules.

The item below references "From Points to Periods" on page 39.

5 What is the author's purpose in writing this article?

A to promote the use of punctuation

* **B** to explain the history of punctuation

C to demonstrate the rules of punctuation

D to illustrate the necessity of punctuation

The item below references "From Points to Periods" on page 39.

6 What is the central thought of the section entitled **"Modern Rebels: Tom Wolfe and e.e. cummings"**?

A Writer Pico Iyer is a rebel who violated punctuation rules.

* **B** Writers today mold punctuation to express themselves individually.

C Tom Wolfe and e.e. cummings have many punctuation mistakes in their works.

D The importance of punctuation in contemporary society should not be overlooked.

The item below references "Dorothy Parker" on page 7.

7 The main idea of this article is that Dorothy Parker

A lost her sense of humor at the end of her life.

B is best known for her screenplay *A Star Is Born*.

C often wished that she could write without using humor.

* **D** is famous for both her wit and her insightful tales of love.

The item below references "Postal Delivery Time Line" on page 19.

8 Which phrase BEST describes the main idea of this time line?

A an in-depth history of the postal service

B an international tribute to the postal service

C a detailed history of technological advances in the postal service

* **D** a chronological list of important events concerning the postal service

The item below references "Video Game Designer" on page 28.

9 The author's main purpose in this article is to

A inspire.

* **B** inform.

C entertain.

D persuade.

STANDARD II: The student will interpret passages taken from textual, functional, and recreational reading material.

OBJECTIVE

2. Draw conclusions.

ELIGIBLE CONTENT

- Draw conclusions based on information in one or more passages.

SAMPLE ITEMS

The item below references "Dorothy Parker" on page 7.

1 What can the reader conclude about Dorothy Parker's time in school?

A She learned many practical skills.
* **B** She cared little about her education.
C She wrote many humorous essays that got her in trouble.
D She learned everything she needed to know to become a great writer.

The item below references "Dorothy Parker" on page 7.

2 What can the reader conclude from the poem about Dorothy Parker's attitude toward roses?

A She appreciates roses as examples of perfection.
B She believes roses symbolize a romantic relationship.
C She thinks roses are a poor substitute for time spent traveling.
* **D** She feels roses are fine but she would like something more substantial.

The item below references "Dorothy Parker" on page 7.

3 Which part of the poem demonstrates Dorothy Parker's wit?

A "A single flow'r he sent me, since we met."
B "Deep-hearted, pure, with scented dew still wet—"
C "Love long has taken for his amulet/One perfect rose."
* **D** "Why is it no one ever sent me yet/One perfect limousine?"

The item below references "Flight Simulator" on page 31.

4 What makes a simulator different from other training methods?

* **A** It reproduces actual conditions.
B It is used only for flight training.
C It is designed by professional trainers.
D It allows people to perform their jobs right away.

The item below references "Flight Simulator" on page 31.

5 A simulator for a space station is probably used to

A study conditions in space.

B launch the space shuttle into orbit.

C form a satellite link among nations.

* **D** prepare astronauts for living in space.

The item below references "In and of Ourselves We Trust" on page 10.

6 What can you conclude about Andy Rooney from this newspaper column?

A He believes most people mistrust others.

* **B** He considers himself a law-abiding citizen.

C He thinks that he is perfect.

D He trusts the Internal Revenue Service.

The item below references "In and of Ourselves We Trust" on page 10.

7 Rooney's statement "We do what we say we'll do. We show up when we say we'll show up" supports his belief that Americans are

A proud.

B prompt.

* **C** trustworthy.

D complacent.

The item below references "Just Two Points Make One Dream Come True" on page 12.

8 What is the attitude of the Wolverines towards Dobbins?

A lenient

B tolerant

* **C** admiring

D flattering

The item below references "The Terms of Trade" on page 21.

9 Trade barriers tend to have the hardest impact on the

A country importing the products.

* **B** people buying the imported products.

C domestic industries selling the same products.

D international organization resolving trade disputes.

The item below references "The Globe Theater" on page 42.

10 What is apparent from the seating arrangements at the Globe?

A There was one ticket price for all.

B The audience appreciated fine music.

C Trap doors allowed for dramatic entrances.

* **D** There were distinctions among social classes.

The item below references "Postal Delivery Time Line" on page 19.

11 Which date indicates the first effect of scientific advances on the delivery of the mail?

A 1639
* **B** 1813
C 1832
D 1918

The item below references "Postal Delivery Time Line" on page 19.

12 What might be seen as a major trend in postal service?

* **A** speeding up the time of delivery
B making stamps attractive to collectors
C offering service to the common people
D providing increased security for postal customers

The item below references "Saga of a Seagoing Dog" on page 15.

13 Schipperkes helped barges navigate the canals by

A swimming alongside the barges.
B smelling the thick fog to locate land.
C alerting the captain of passengers overboard.
* **D** encouraging tow horses to continue walking.

The item below references "Saga of a Seagoing Dog" on page 15.

14 When the author first met the dog, Santos seemed

A cheerful.
B miserable.
* **C** unfriendly.
D affectionate.

The item below references "Saga of a Seagoing Dog" on page 15.

15 Why did Diego tear open the "last package of tortilla chips, crackling the bag noisily"?

A to help in the preparation of lunch
B to offer some food to the port captain
* **C** to tempt the dog to come out of hiding
D to encourage the family to eat before leaving

The item below references "Park It" on page 24.

16 Why is an area near Pensacola referred to as "The Canoe Capital of Florida"?

A It has a long coastline.
B It is situated in a quiet harbor.
* **C** It has many slow-moving streams.
D It is situated in the state forest system.

STANDARD II: The student will interpret passages taken from textual, functional, and recreational reading material.

OBJECTIVE

3. Determine cause and effect.

ELIGIBLE CONTENT

- Infer the cause(s) of effect(s) stated or implied in a passage.
- Infer the effect(s) of cause(s) stated or implied in a passage.

SAMPLE ITEMS

The item below references "Flight Simulator" on page 31.

1 The author's experience with the flight simulation company probably

A prepared him to be a pilot.
B led him to pursue a degree in electronics.
C taught him a lot about the Apollo program.
* **D** helped him get a position with the space program.

The item below references "Flight Simulator" on page 31.

2 What is one of the common causes of long work hours in this field?

A unscheduled space launches
B team meetings to discuss future projects
* **C** unexpected events during space missions
D special training to prepare new employees

The item below references "Just Two Points Make One Dream Come True" on page 12.

3 What happens because Dobbins shows his scrapbook to Fisher?

* **A** Dobbins makes the team.
B Dobbins sits in the stands.
C Dobbins drives to Atlanta.
D Dobbins plays his first game.

The item below references "Just Two Points Make One Dream Come True" on page 12.

4 What happens to Dobbins because Michigan recruits the Fab Five?

A He joins an opposing team.
B He drives to different cities.
C He is traded to another team.
* **D** He is dropped from the team.

The item below references "The Globe Theater" on page 42.

5 Workmen were able to haul materials across the Thames River because

* **A** it was frozen over.

B London Bridge had been built.

C they had specialized equipment.

D it was less crowded than London Bridge.

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

6 How does a raised level of nitrogen in the soil affect the water supply?

* **A** It increases pollution.

B It encourages oxygen.

C It activates organisms.

D It introduces nutrients.

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

7 What effect does an increased level of nitrogen have on non-native grasses?

A It blocks nutrients.

* **B** It stimulates growth.

C It activates diversity.

D It inhibits development.

The item below references "Video Game Designer" on page 28.

8 What convinced Atari of the author's creative abilities?

A her early drawings

B her job application

C her scientific sketches

* **D** her award-winning film

The item below references "Point of View on Advertising" on page 36.

9 Advertising could hasten the depletion of raw materials by

A lowering environmental protection.

B causing inefficient production methods.

* **C** generating over-consumption of products.

D providing excess profits to manufacturers.

STANDARD II: The student will interpret passages taken from textual, functional, and recreational reading material.

OBJECTIVE

4. Detect propaganda; distinguish fact from opinion.

ELIGIBLE CONTENT

- Identify an author's purpose or point of view in one or more passages.
- Identify vocabulary or other uses of language that are intended to persuade or influence the reader to agree or disagree with a point of view and/or take a particular action.
- Identify the purpose of specific persuasive techniques, but not label or define the techniques.
- Distinguish facts from opinions based on a passage.

SAMPLE ITEMS

The item below references "Point of View on Advertising" on page 36.

1 Which of the following ideas from the editorial is a FACT?

* **A** Manufacturers profit by the production of goods.

B Most advertising is designed to brainwash people.

C Someone who wants to sell something must advertise.

D Television commercials damage the minds of children.

The item below references "Point of View on Advertising" on page 36.

2 According to the editorial, what would happen without advertising?

A Citizens would become wiser consumers.

B Farming would dominate economic decisions.

C Pollution and depletion of natural resources would increase.

* **D** Exchange of goods and services would be drastically reduced.

The item below references "Point of View on Advertising" on page 36.

3 Which of the following most accurately states the point of view of the author?

A Advertising contributes to pollution.

B Advertising is insulting to an intelligent adult.

* **C** Advertising is an essential component of a healthy economy.

D Advertising causes people to buy things they don't want or need.

The item below references "Point of View on Advertising" on page 36.

4 What method does the author use to convince the reader of his viewpoint?

A citing statistics

B quoting experts

C frightening the reader

* **D** contradicting the critics

The item below references "Point of View on Advertising" on page 36.

5 Which of the following ideas from the editorial is an OPINION?

A Advertising affects the flow of goods and services.

B Some magazines contain multicolored advertisements.

* **C** Advertising causes consumers to buy items they do not need.

D Commercial television stations depend on advertising for revenue.

The item below references "In and of Ourselves We Trust" on page 10.

6 Why does Rooney change from "I" to "we" about halfway through the newspaper column?

A to urge readers to obey traffic laws

B to enable readers to understand the social contract

* **C** to encourage readers to identify with his point of view

D to lead readers to consider conventions more important than laws

STANDARD II: The student will interpret passages taken from textual, functional, and recreational reading material.

OBJECTIVE

5. Recognize statements that adequately summarize a passage.

ELIGIBLE CONTENT

None specified.

SAMPLE ITEMS

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

1 Which statement BEST summarizes the article?

A Scientists have discovered that when nitrogen levels in the soil increase, water supplies can become contaminated.

B Ecologists have discovered that air-borne nitrogen disrupts grassland growth and can affect plant communities in diverse areas.

* **C** Ecologists have discovered that high levels of nitrogen cause non-native plants to grow while restricting the growth of native plants.

D Scientists have discovered that increased levels of nitrogen stimulate the growth of non-native plants but they also poison the water supply.

The item below references "In and of Ourselves We Trust" on page 10.

2 Which set of statements BEST summarizes this newspaper column?

A The Internal Revenue Service needs to enforce stronger tax laws. Otherwise, no one will pay taxes.

* **B** The stability of society is built on trust. Without trust the contract we have with each other would be destroyed.

C If we did not trust each other, there would be a tax revolt. The contract we have with each other would be destroyed.

D Through trusting each other to obey laws, we build a solid government. We must have a strong police force in order to ensure that stability.

300

The item below references "From Points to Periods" on page 39.

3 Which set of statements BEST summarizes the article?

* **A** Punctuation has evolved throughout history. The guidelines and rules we now use were introduced by the 18th century; however, some modern writers have been known to change the rules to fit their individual needs.

B Punctuation has changed very little from the days of the Greeks and Romans. Some of the same punctuation marks and guidelines used in the 16th century are still used today, causing some contemporary authors to challenge existing rules.

C The purpose of punctuation has remained constant although the punctuation marks themselves have changed. Therefore, some 20th century writers agree that to ignore these rules may be considered a type of rebellion against society.

D Punctuation was introduced to the world by the Greeks and the Romans. Until the 17th century the purpose of punctuation was not to clarify grammar, but to aid people in reading aloud. As the purpose of punctuation changed, so have the rules, and very few rules currently remain.

The item below references "Video Game Designer" on page 28.

4 Which set of statements BEST summarizes the author's advice for entering and working in the video game design business?

A Obtain a master's degree in computers and open your own design house. Develop your own games and then sell them to other companies.

B Pursue a double major in art and computers and form a team of developers. Sell your games to software companies and collect royalties.

C Major in animation and find a job that will teach you how to use computers. Improve your skills by taking night classes and attending children's cultural events.

* **D** Obtain a degree in an art-related field and learn as much as you can about computers. Continue to improve your skills and keep in touch with what kids are doing.

The item below references "Just Two Points Make One Dream Come True" on page 12.

5 Which set of statements BEST summarizes the story?

A Sean Dobbins wanted to score a two-point basket during his college basketball career. He scored with a free throw during his sophomore year but still wanted a two-point basket. Even though he never got to play, his teammates loved his spirit.

* **B** Sean Dobbins dreamed of making a two-point basket during his college basketball career. Through a number of circumstances, he almost lost out on that dream. But in his senior year he finally realized his goal when he scored a basket in the final seconds of a tournament game.

C Sean Dobbins wanted to make a basket during his college basketball career. Even though he scored with a free throw, it was not good enough. He thought that he had two years left in which to score a basket. But unfortunately he had to leave the team when the Fab Five were recruited.

D Sean Dobbins was able to get on the Wolverines team by showing his high school scrapbook to the coach. He played for two seasons but had to leave the team in his junior year when the Fab Five were recruited. He never lost his enthusiasm and got a chance to play again with the team in his senior year.

The item below references "Saga of a Seagoing Dog" on page 15.

6 Which set of statements BEST summarizes the story?

A Santos repeatedly falls or jumps overboard but is returned each time to his family's sailboat. One time he is lost off South America but is brought back by a port captain.

* **B** The author reluctantly accepts a puppy onboard his sailboat. The dog, intelligent and full of fun, endears himself to the family and has a variety of adventures on and off the boat.

C *Breath*, the family sailboat, becomes the home of a happy, adventurous dog. At the end of the story, Santos jumps overboard to play on shore with another dog and some children.

D A family adopts a schipperke puppy that was bred to be aboard a boat and help with navigation. As a puppy, Santos falls overboard twice; one of those times he comes back to the family with a skin diver.

The item below references "The Globe Theater" on page 42.

7 Which set of statements BEST summarizes the article?

A The Globe is the most famous theater in history because Shakespeare's plays were performed there. It burned down and then was rebuilt a year later.

B The Globe's design made it the ideal theater for Shakespeare's plays. For this reason, it was reconstructed after many years and despite difficult problems.

C The Globe was originally constructed by the Burbage brothers on the site of an earlier playhouse. After years as the site of Shakespeare's plays, it was razed and then rebuilt.

* **D** The Globe, where Shakespeare's plays were first performed, is possibly the most famous theater in history. A rebuilt version of it was opened in London after a period of reconstruction.

STANDARD III: The student will apply critical analysis strategies and judge texts critically to comprehend passages from textual, functional, and recreational reading material.

OBJECTIVE

1. Recognize fallacies of logic and judge strength of argument.

ELIGIBLE CONTENT

- Recognize faulty logic in one or more passages.
- Evaluate faulty logic in one or more passages.
- Recognize the strength(s) or weakness(es) of argument(s) in one or more passages.
- Evaluate the strength(s) or weakness(es) of argument(s) in one or more passages.
- Recognize terminology used by an author to strengthen argument(s), but not label or define the terminology.

SAMPLE ITEMS

The item below references "Point of View on Advertising" on page 36.

1 Which of the following ideas from the editorial is an example of faulty logic?

A To let people know what is for sale, sellers have to advertise.

* **B** Without amusing commercials on TV, television stations would go bankrupt.

C You cannot take a company to court for selling something a buyer doesn't need.

D Manufacturers often contribute to pollution and hasten the depletion of our raw materials.

The item below references "Point of View on Advertising" on page 36.

2 Read the following statement from the editorial.

Search as you may, you will never find in American court records a single case of an innocent citizen being forced by advertisers or advertising into buying something he or she didn't want.

Which phrase is used by the author to avoid a serious flaw in logic?

A "Search as you may"

B "an innocent citizen"

C "into buying something"

* **D** "in American court records"

The item below references "Point of View on Advertising" on page 36.

3 Which technique does the author use to strengthen his argument about advertising?

A using personal testimonies

B giving statistics to show effectiveness

* **C** addressing both positive and negative aspects

D describing advertisements that were successful

The item below references "In and of Ourselves We Trust" on page 10.

4 What is the most convincing reason Rooney gives for not going through the red light?

A It is against the law.

B We just don't go through red lights.

* **C** It is part of a contract we have with each other.

D We stop in this situation because it makes us feel proud.

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

5 Which idea from the article is not supported by evidence?

* **A** Air-borne nitrogen is likely to disrupt other plant communities.

B Wedin and Tilman studied the effects of applied nitrogen for more than ten years.

C Air-borne nitrogen pollution from cars and power plants was approximated in a study.

D Changes in the amount of nitrogen in the soil change the amount of nitrogen in water supplies.

The item below references "Postal Delivery Time Line" on page 19.

6 If Leann wants to make the point that mail delivery was often difficult, which fact would be BEST to include in her research paper?

A In 1896, Rural Free Delivery of mail began.

B In 1963, Zip Code numbers were put into use.

* **C** In 1799, Congress passed a death penalty for robbing the mail.

D In 1941, a post office on wheels, called Highway Post Office (HYPO), was initiated.

The item below references "Park It" on page 24.

7 How does the author support the statement that the Pensacola area is "one of the most beautiful and well-preserved natural environments in the country"?

A by listing recreational activities

B by naming state recreation areas

* **C** by describing the scenery and wildlife

D by outlining the geographic boundaries

STANDARD III: The student will apply critical analysis strategies and judge texts critically to comprehend passages from textual, functional, and recreational reading material.

OBJECTIVE

2. Analyze literary elements.

ELIGIBLE CONTENT

- Analyze literary elements as they relate to the comprehension of a passage, but not label or define the elements. (Note: Literary elements are limited to theme, character, tone, setting, mood, plot, and literary point of view.)

SAMPLE ITEMS

The item below references "Dorothy Parker" on page 7.

1 What is the theme of the poem?

A Love will last no matter what gifts are given.

* **B** Women desire more than symbolism in a gift.

C Love should be shown through inexpensive gifts.

D Women know a single rose is a better gift than jewelry.

The item below references "Dorothy Parker" on page 7.

2 What is the tone of the poem?

A angry

* **B** ironic

C tender

D dramatic

The item below references "Saga of a Seagoing Dog" on page 15.

3 What is the tone of this story?

A nostalgic regret

B harsh irritation

* **C** gentle amusement

D sarcastic mockery

The item below references "Just Two Points Make One Dream Come True" on page 12.

4 What word BEST describes Dobbins's character?

A critical

B humorous

C pessimistic

* **D** determined

The item below references "Just Two Points Make One Dream Come True" on page 12.

5 What method does the author use to dramatize the final scene of his story?

A He interviews the coach.

* B He quotes two ballplayers.

C He mentions the scrapbook.

D He discusses team motivation.

STANDARD III: The student will apply critical analysis strategies and judge texts critically to comprehend passages from textual, functional, and recreational reading material.

OBJECTIVE

3. Demonstrate understanding of figurative language and analogy.

ELIGIBLE CONTENT

- Analyze the use of analogy in a passage.
- Analyze how figurative language enhances the comprehension of passages, but not label or define the figurative language. (Note: Types of figurative language are limited to simile, imagery, metaphor, personification, and hyperbole [overstatement].)

SAMPLE ITEMS

The item below references "Dorothy Parker" on page 7.

1 Who or what is the messenger in the line, "All tenderly his messenger he chose"?

* **A** flower

B limousine

C amulet

D heart

The item below references "Flight Simulator" on page 31.

2 What does the author mean by "getting into a person's senses"?

A studying the physical effects of stress

B measuring the intelligence of humans

C controlling a person's thoughts and feelings

* **D** understanding what a person is seeing and hearing

The item below references "Video Game Designer" on page 28.

3 When the author says, "Another way to go is to open up your own house," she is comparing a working group to a

A team.

* **B** family.

C school.

D neighborhood.

STANDARD IV: The student will utilize strategies that enhance comprehension of textual, functional, and recreational reading material.

OBJECTIVE

1. Determine word meaning through the use of context clues.

ELIGIBLE CONTENT

- Determine the meaning of words or phrases in context. (Note: Target words or phrases may include uncommon meanings of common words or phrases; specialized or technical vocabulary; and words or phrases that might be unfamiliar to most Grade 11 students.)

SAMPLE ITEMS

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

1 What is the meaning of the word *interlopers* as used in the third paragraph?

A visitors

* **B** invaders

C achievers

D impostors

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

2 What is the meaning of the word *enhancing* as it is used in the first paragraph?

A creating

B decreasing

* **C** stimulating

D illuminating

The item below references "Pollution's Hidden Toll on Native Plants" on page 34.

3 Read this sentence.

Though plants need nitrogen to grow, the researchers found that the elevated nitrogen levels stimulated the growth of grasses imported from Europe while impairing the growth of native grasses.

What is the meaning of the word *impairing* as it is used here?

A hastening

* **B** damaging

C increasing

D disintegrating

The item below references "Point of View on Advertising" on page 36.

4 Read the following sentence.

Another charge frequently made against the advertising industry is that advertising causes people to buy what they don't need or want. An unusual assertion indeed . . .

What does the word *assertion* mean as used here?

A denial

B question

* **C** statement

D predicament

The item below references "Saga of a Seagoing Dog" on page 15.

5 Read the following sentence from the story.

He had been an endlessly amusing little rogue.

What does the word *rogue* mean as it is used here?

* **A** rascal

B friend

C stranger

D monster

The item below references "Saga of a Seagoing Dog" on page 15.

6 What does the author probably mean by the word *unbidden* when he writes that Santos "would creep unbidden into the lonely helmsman's lap"?

A not aided

* **B** not invited

C not ashamed

D not observed

The item below references "From Points to Periods" on page 39.

7 Read the following sentence from the last paragraph under **"Punctuation Heats Up."**

It was Henry Watson Fowler and Francis George Fowler . . . who advocated easing up a bit.

What is the meaning of the word *advocated* as it is used in this paragraph?

A required

B continued

C discovered

* **D** recommended

The item below references "From Points to Periods" on page 39.

8 Read the following sentences from the article.

However, the purpose of punctuation was still elocutionary, not syntactical. The poet Ben Jonson was the first to recommend that punctuation marks be used to help readers figure out the meaning of a sentence, and not just how to recite it.

What is the meaning of *elocutionary* as it is used here?

* A related to speaking publicly

B related to memorizing words

C related to arranging sentences

D related to understanding word meanings

STANDARD IV: The student will utilize strategies that enhance comprehension of textual, functional, and recreational reading material.

OBJECTIVE

2. Demonstrate the ability to preview and predict.

ELIGIBLE CONTENT

- Preview text features to make a prediction about the text content. (Note: Text features may include headings, subheadings, illustrations, footnotes, captions, topic sentences, book jackets, introductory paragraphs, and such graphic displays as charts, maps, graphs, and timelines.)

SAMPLE ITEMS

The item below references "Video Game Designer" on page 28.

1 If the next subheading in this article were "WHERE WE'RE HEADED," which of the following subjects would most likely be covered in that paragraph?

A the reader's future needs

B the future of children's culture

C the author's plans for the future

* **D** the future of video game design

The item below references "From Points to Periods" on page 39.

2 If the next subheading in the article were **"The Electronic Age,"** which of the following questions would most likely be answered in the paragraph?

A Has punctuation advanced the electronic revolution?

* **B** Will the rules of punctuation change in the computer era?

C Has punctuation been made obsolete by the electronic age?

D Will computer software adjust to punctuation requirements?

STANDARD IV: The student will utilize strategies that enhance comprehension of textual, functional, and recreational reading material.

OBJECTIVE

3. Discern organizational patterns.

ELIGIBLE CONTENT

- Determine the organizational pattern of a passage, but not label the pattern. (Note: Organizational patterns may include chronological order, spatial order, order of importance, comparison and contrast, cause and effect, and main idea with examples or anecdotes.)

SAMPLE ITEMS

The item below references "Flight Simulator" on page 31.

1 In the section titled "HOW I GOT STARTED," information is organized by

A date.
B skill.
* **C** time.
D importance.

The item below references "From Points to Periods" on page 39.

2 How is the information in this article organized?

* **A** events presented in the order they occurred
B general statements clarified by specific examples
C overall descriptions followed by detailed analyses
D definitions supported through references to authorities

The item below references "Park It" on page 24.

3 How are the first and second parts of this brochure different?

* **A** The first part promotes the features of parks; the second part lists factual information.
B The first part lists sequential details; the second part promotes the highlights of parks.
C The first part lists details; the second part contains chronological information about parks.
D The first part contains chronological information about parks; the second part describes various features.

The item below references "Postal Delivery Time Line" on page 19.

4 This time line is organized according to

* A when the events happened.
B where the events happened.
C the importance of the events.
D the people involved in the events.

The item below references "Point of View on Advertising" on page 36.

5 How is this editorial organized?

A main idea supported by statistical examples
* B critical ideas contradicted by logical statements
C a number of topics introduced for further development
D a number of topics considered, all of historical significance

The item below references "Video Game Designer" on page 28.

6 Information in the article is organized according to

A isolated blocks of information.
* B separate sections with headings.
C steps explaining how to enter the field.
D important events in the author's career.

The item below references the paragraph and bus schedule "Buses Leaving Mobile" on page 44.

7 The bus schedule presents information in

A related blocks of places and times.
* B separate columns with headings.
C steps telling how to buy a ticket.
D interesting sites to see en route.

The item below references the paragraph and bus schedule "Buses Leaving Mobile" on page 44.

8 The information in the bus schedule is organized by

A bus numbers numerically ordered.
B transfer places ordered by distance.
C destinations alphabetically ordered.
* D departure times chronologically ordered.

STANDARD IV: The student will utilize strategies that enhance comprehension of textual, functional, and recreational reading material.

OBJECTIVE

4. Demonstrate the ability to locate information in reference material.

ELIGIBLE CONTENT

- Comprehend information in reference materials. (Note: Reference materials may include glossaries; dictionaries; indexes; tables of contents; appendixes; and research sources such as atlases, almanacs, encyclopedias, readers' guides, and both print-based and electronic card catalogs.)

SAMPLE ITEMS

The item below references "Park It" on page 24.

1 Which park has shower facilities?

A Fort Barrancas

B Naval Live Oak Reservation

C Blackwater River State Park

* **D** Perdido Key Area Johnson Beach

The item below references "The Terms of Trade" on page 21.

2 Jesse decides to support his paper's arguments with concrete examples of countries that are putting free trade agreements into practice. Which heading should Jesse first research at the library?

A Tariffs

* **B** NAFTA

C Globalization

D Protectionism

The item below references "The Terms of Trade" on page 21.

3 What is the BEST way for Jesse to locate countries that have recently established trade barriers?

* **A** by gathering information from the WTO

B by researching the history of the GATT

C by discovering more facts about free trade

D by investigating the theory of globalization

The item below references "The Terms of Trade" on page 21.

4 A tax on imported products is called

* **A** a tariff.

B a quota.

C an export.

D a trade barrier.

The item below references "The Terms of Trade" on page 21.

5 Products that are brought from another country and used domestically are called

A tariffs.

B quotas.

C exports.

* **D** imports.

The item below references "The Terms of Trade" on page 21.

6 What is the trend toward a worldwide market that has no national boundaries called?

A free trade

B trade barriers

* **C** globalization

D protectionism

The item below references "The Terms of Trade" on page 21.

7 Jesse wants to trace the movement toward a worldwide market. He wants to include the resolution of recent trade conflicts in his research paper. Under which heading should Jesse look?

* **A** WTO

B GATT

C Protectionism

D Trade barriers

The item below references the paragraph and bus schedule "Buses Leaving Mobile" on page 44.

8 What is the number of the bus that will make the most stops before reaching its final destination?

A 46

B 498

* **C** 575

D 109

The item below references the paragraph and bus schedule "Buses Leaving Mobile" on page 44.

9 What is the number of the bus that stops in Montgomery, Alabama, before it reaches its final destination?

* **A** 498

B 73

C 575

D 109

The item below references the paragraph and bus schedule "Buses Leaving Mobile" on page 44.

10 To which of the following cities is there a nonstop bus from Mobile?

A Dalton, GA

* **B** Glasgow, KY

C Lexington, KY

D Carbondale, IL

The item below references the paragraph and bus schedule "Buses Leaving Mobile" on page 44.

11 What can you determine about the buses labeled "EXPRESS"?

A These buses drive faster.

B These buses don't cost as much.

C These buses carry more passengers.

* **D** These buses don't make any stops.

The item below references the paragraph and bus schedule "Buses Leaving Mobile" on page 44.

12 What time does the bus to Carbondale, IL, leave Mobile?

A 10:01 a.m.

B 10:15 a.m.

C 12:30 p.m.

* **D** 3:25 p.m.

The item below references the paragraph and bus schedule "Buses Leaving Mobile" on page 44.

13 A friend asks Timothy which bus to take to travel from Mobile to Montgomery. What is the number of the bus he should take?

A 46

* **B** 498

C 73

D 109

ANSWER KEY

ANSWER KEY FOR PASSAGES WITH ITEMS

"Dorothy Parker"
1. D
2. A
3. D
4. B
5. B
6. B
7. A
8. D
9. D

"In and of Ourselves We Trust"
1. B
2. C
3. C
4. C
5. A
6. A
7. B

"Just Two Points Make One Dream Come True"
1. A
2. A
3. A
4. D
5. C
6. D
7. B
8. B

"Saga of a Seagoing Dog"
1. C
2. C
3. B
4. C
5. A
6. B
7. D
8. B
9. D
10. B

"Postal Delivery Time Line"
1. A
2. C
3. D
4. B
5. A
6. D

"The Terms of Trade"
1. A
2. B
3. B
4. A
5. A
6. D
7. C
8. C

"Park It"
1. C
2. D
3. D
4. A
5. C
6. B
7. D
8. A
9. C
10. C

"Video Game Designer"
1. B
2. B
3. C
4. D
5. B
6. D
7. D

"Flight Simulator"
1. D
2. D
3. A
4. C
5. D
6. D
7. C
8. C
9. D

"Pollution's Hidden Toll on Native Plants"
1. C
2. B
3. C
4. B
5. B
6. B
7. A
8. A
9. C

"Point of View on Advertising"
1. B
2. C
3. D
4. B
5. D
6. A
7. C
8. C
9. D
10. C
11. C

"From Points to Periods"
1. B
2. A
3. A
4. A
5. D
6. B
7. B
8. A

"The Globe Theater"
1. A
2. D
3. A
4. A
5. D

"Buses Leaving Mobile"
1. C
2. A
3. B
4. D
5. D
6. B
7. D
8. B